THE MYXOMYCETES

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To the memory of
THOMAS HUSTON MACBRIDE

1848-1934

In recent years there has been a marked revival of interest in the Myxomycetes. Improved methods of culture, in the form of 2-member cultures of a pure strain of a myxomycete of known origin combined with a known strain of bacteria and, as yet to a lesser extent, of the plasmodium alone on a nutrient medium, have resulted in a number of papers discussing the physiology, cytology, and variation in ploidy of both amoebae and plasmodia, and incidentally stressing the modifications which may appear under cultural conditions. These and other studies, added to the long-known variations which a single species may assume within the wide range of environmental influences occurring in natural habitats, make it clear that many of our bases for classification must be reconsidered. It is too early as yet to evaluate the full impact of this new information on the taxonomy of the group, but in the meantime a survey of the known species, even though they are arranged in a conservative framework, may serve a useful purpose as a summary of current taxonomic approach.

The authors are aware of many of the deficiencies of the present treatment. It seems quite certain that some forms here recognized as species will, when better known, be reduced to synonymy with other species, and that some common and widely distributed species which show wide variation will perhaps be split. At a higher level, some genera may come to be regarded as superfluous, others will be broken up, and the families, orders and higher categories will be modified and rearranged. This will always be true of a work of this kind. An attempt has been made to cite and comment upon some of the suggested changes which have already been proposed and, when it seems appropriate, to mention others which may be worthy of consideration.

The illustrations are based on sketches and specimens from the Iowa collection sent to Mrs. Allen, who supplemented such material by the study of specimens from her own collection and from other sources, notably the material in the collection at the Philadelphia Academy of Natural Sciences, including the Bilgram Collection, belonging to the Leidy Microscopical Society, also housed at the Academy.

We are grateful to the numerous correspondents who have sent us material for study. It is impossible to mention them all by name, but among those who have made noteworthy contributions are Dr. Wm. Bridge Cooke, Mme. N. E. Nannenga-Bremekamp, Dr. Marie L. Farr, Dr. Travis E. Brooks, Dr. Donald T. Kowalski, and Dr. K. S. Thind. To these, and to many others we extend our hearty thanks.

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General Morphology and Life History

T.

The Myxomycetes are fungus-like organisms characterized by an assimilative phase in the form of a free-living, multinucleate, acellular, mobile mass of protoplasm, the *plasmodium*, and a propagative phase, consisting of a mass of spores borne in a simple or complex, membranous, non-cellular spore case. Within the latter, in addition to the spores, there is often a system of free or netted threads forming a *capillitium*. Certain groups also contain characteristic calcareous accretions within or without the spore case, or both.

The members of the group are widely distributed, occurring wherever conditions on the earth's surface permit growth of vegetation, but are particularly abundant in forested areas, where they appear in great profusion on dead and decaying wood, or woody litter, and on dead leaves. Not rarely the plasmodium creeps up the stems and over the leaves of living plants, and there fruits. If such plants happen to be cultivated, minor damage may be done, but such damage is incidental and there is scanty suggestion of true parasitism. On the other hand, the Myxomycetes cannot be described as saprobes. Characteristically they feed on living bacteria and on fungal sporophores, spores, and

mycelium as well as on bits of non-living organic matter. Their nutrition is typically holozoic, but their plasmodia are also capable of absorbing food in solution.

As discussed later, there has been and still is much disagreement concerning the classification and relationships of the group. It was quite natural that early collectors, finding them in the same situations and occurring with the fungi in their ordinary habitats, should have classified them with the fungi. Whether this was justified or not, it remains true that their collection and study has been mainly by mycologists, which fact has doubtless had some influence on many of the discussions as to their nature.

General Morphology

The Sporophore-As collected in the field, in the mature stage, the fructifications occur in three generally distinguishable forms, as sporangia, as plasmodiocarps and as aethalia. In the sporangial forms, one to many sporangiain some cases thousands-develop nearly simultaneously from a single plasmodium. The individual sporangium is usually of characteristic shape, size and color and in most species is rather consistently stalked or sessile. The sporangia of a cluster are based on a horny, membranous sheath, the hypothallus, in some species very conspicuous and in others difficult to see. Lime, when present, may be in the form of amorphous granules or of highly characteristic crystals. It may be restricted to the stalk and its continuation within the sporangial cavity, the columella, which may arise from the base in sessile forms; it may be deposited in the hypothallus or the capillitium; it may form an outer broken or solid layer on the peridium, or it may occur in various combinations of these possibilities. The capillitium may be entirely limy, as in typical species of Badhamia or the lime may be aggregated in nodes connected by limeless tubules, as in Physarum. A plasmodiocarp is like a sporangium but is more or less elongated and often forms a network on the substratum. It follows, in general, the lines of the major veins of the plasmodium from which it arose, often with breaks, and sometimes the breaks are so many that some of the segments are sporangiumlike and are, indeed, sessile sporangia. It follows that the line between sporangiate fruitings and plasmodiocarpous fruitings is not always clear, but in species which are characteristically plasmodiocarpous there is nearly always some indication of that fact even in fruitings that include a large proportion of sporangia. Plasmodiocarps are nearly always sessile; very rarely, when formed on the lower side of a branch or log they may be pendent by delicate threads. In forming an aethalium, the strands of the plasmodium hold together in a tangled pulvinate mass and while the inner portion proceeds to form spores exactly as in a sporangium, the protoplasm is withdrawn from the outer tubes, which then collapse and adhere together to form a crust. Under some circumstances the development is checked and the final fruiting resembles a densely packed cluster of sporangia, but this is rarely the case. A pseudoaethalium is a mass of closely compacted sporangia which simulate an aethalium, but in which individual sporangia are clearly distinguishable at maturity or, in the special case of Dictydiaethalium (Baker, 1933), almost to maturity.

Cohen (1942) studying the variability of the fructifications of Didymium squamulosum, Physarum polycephalum, and Badhamia foliicola, reached the

conclusion that the type of fructification formed is probably dependent on the surface tension of the plasmodium. A low surface tension would tend to produce plasmodiocarps, whereas a higher surface tension would favor the formation of sessile, spherical sporangia. A stalked sporangium would result when material is secreted preferentially at the substrate-plasmodium interface. However, it is undeniable that some forms, such as *Hemitrichia serpula*, seem always to produce plasmodiocarps, whereas others, such as species of *Stemonitis*, never do. Nor is Cohen's explanation entirely in accord with laboratory and field observations mentioned later.

In the endosporous Myxomycetes, a peridium typically surrounds the spore mass. At maturity, the peridium may open by a predetermined lid, split irregularly or along definite lines of dehiscence, or slough off in various ways, some of which are sufficiently characteristic to be useful in species determination. In a number of species the peridium evanesces very early in the formation of the sporophore (Alexopoulos 1960, Goodwin, 1961) while the spores are being developed, so that the mature spores are in no way covered. In the so-called exosporous types, the spores appear to be produced on the outside of a columnar, poroid, or morchelloid fructification.

One fact should be stressed. The plasmodium may develop its characteristic fruiting stage in less than 24 hours. If this occurs under conditions which cause unduly rapid drying or if repeated rains check the process, great variation may be induced. Under such influences, species which ordinarily have stalks may be sessile or nearly so, or the stalks may be inordinately long; sporangiate species may form plasmodiocarps; aethalioid forms may approach the sporangiate type; the characteristics and disposition of limy secretions may be altered; spore maturation may be checked, resulting in spore-like bodies which are much larger than fully matured spores. Cold weather, and particularly frosts, may induce similar alterations. Such variations are in large part responsible for the extensive synonymy found in the group. Great caution is indicated in describing as new, specimens which are the result of such environmental influences. They are not "abnormal"; they are the natural response of the organism involved to particular stimuli and must be so regarded. Giving them taxonomic status as named varieties serves only to complicate the nomenclature and to extend the meaning of the category variety beyond its legitimate significance.

Capillitium and pseudocapillitium. A true capillitium, when present, is formed just before spore delimitation begins. In those Physarales and Trichiales which have been investigated, a system of tubular invaginations and vacuoles appears in the protoplasm at the time of capillitial formation. In Badhamia gracilis and Didymium iridis (Welden, 1955)—and perhaps in other members of the Physarales—capillitial material is deposited within the vacuolar tubes. In Trichia sp. and Hemitrichia clavata, according to Harper and Dodge (1914), capillitial material is deposited on the surface of the vacuolar tubes as well as within them. In Arcyria cinerea, another of the Trichiales, all capillitial material, including surface ornamentations, is deposited within the vacuolar system, beneath the surface of the membrane binding it, as is clearly shown in a very recent electron microscope study (Mims, 1969). The situation in the Stemonitales is less clear. Bisby (1914) reported that the capillitium of Stemonitis fusca is deposited in invaginations originating from the peridial membrane and the columella, but neither Ross (1957, 1960) nor Goodwin (1961) found

evidence of such invaginations or tubular vacuoles. The capillitial strands in Comatricha and Lamproderma are extensions of the strands which form the stalk and columella and which bend outward, grow, and branch toward the peridium. In Stemonitis (Ross, 1957) the capillitium originates both from the apex of the columella and independently from the surrounding protoplasm. The two systems branch and anastomose, and eventually join. In the Physaraceae, as previously stated, the capillitium may be entirely limy, as in a typical Badhamia, or may consist of a system of hyaline tubules supporting calcareous nodes as in Physarum. In the other families lime is rarely present in the capillitium even though lime may be characteristically deposited in other parts of the fructification. Even in Physarum, the amount of lime present in the capillitium and the peridium seems to be dependent to at least some extent on the environment, limeless or nearly limeless fruitings occurring occasionally in many species which typically secrete lime.

The chemical composition of the capillitium has not been determined with certainty. Chitin has been reported to be present in the capillitium of *Stemonitis fusca* (Cihlar, 1916), and of *Hemitrichia serpula* (Locquin, 1947). But in view of the inability of many workers (Ulrich, 1943, Goodwin, 1961) to demonstrate its presence in the majority of species which have been investigated, a re-examination of the whole problem using modern techniques is indicated.

In a number of species the capillitium is so constructed as to be a definite aid in the dissemination of the spores. In such species as Arcyria nutans, A. oerstedtii, Hemitrichia clavata, etc., it is elastic, expanding greatly when the peridium ruptures and shedding large quantities of spores. In Trichia favoginea the elaters which form the capillitium are hygroscopic, twisting and untwisting according to the humidity of the surrounding atmosphere (Ingold, 1940). The spores are thus stirred and some may be forcibly expelled by such capillitial action.

A pseudocapillitium, as it occurs in typical aethalia, usually represents empty strands of the plasmodium from which the protoplasm has been evacuated before spore formation. In *Dictydiaethalium* it is formed from the thickened parts of the sporangial walls, where the individual sporangia have been pressed together, and which remain after the thinner parts of the wall have disappeared. In some genera, such as *Fuligo*, both a true capillitium and a pseudocapillitium are present in the mature aethalium.

The Spores. The spores are nearly always globose although in a few species they are predominantly oval in shape. In color they may vary from hyaline under the lens to almost black, with various shades of violet, pinkish, yellow and brown between. In the darker spores, there is often a strong purplish tinge to the color. In mass the color is more obvious, particularly in the paler forms. Many are brilliant yellow, pink, ferruginous or purple. Even in the very dark-spored species, where the spore-mass is black, there is often a distinct purplish cast. In a few species, best known in Badhamia, but occurring in other genera, the spores are aggregated into characteristic clusters. The spore wall may be perfectly smooth or it may be echinulate, verrucose, or elaborately reticulate. In Echinostelium, the spore wall exhibits characteristic thickenings spaced more or less equidistantly. These characters, as well as size, are remarkably constant, within certain limits, and serve as useful means of identification.

Little is known about the structure and composition of the spore wall. Schuster's (1964) electron micrographs of *Didymium nigripes* spores show two

wall layers. The inner coat gives a cellulose reaction; the outer may consist of chitin, according to that author. Koevenig's (1964) electron micrographs of the spores of *Physarum gyrosum* show three layers.

Swarm Cells and Myxamoebae. When a spore germinates, usually one, but occasionally as many as four, swarm cells or myxamoebae emerge. The immediate environment of the spore at the time of germination determines to some extent whether the emerging protoplast will be flagellated or not. In water or a weak nutrient solution, the spores often release flagellated protoplasts. On a moist surface devoid of free water, they release amoebae. In some species, the entire life cycle may be completed without any flagellate stage if water is withheld throughout (Alexopoulos, 1960). What happens in nature is of course entirely unknown, but there is little reason to believe that the phenomena observed when the organisms are in culture are vastly different from those in the field.

For a long time, the swarm cells of the Myxomycetes were believed to be uniflagellate with a single anterior whiplash flagellum. Elliott (1949) in a study of 59 species showed that the swarm cells typically possess two anterior whiplash flagella one of which, in many species, is much shorter than the other, is recurved, and, because it may be appressed against the protoplast of the swarm cell, is difficult to demonstrate. Locquin (1949) using cinephotomicrography and phase-contrast optics independently found a short, immobile flagellum at the base of the long active one in all 58 species he studied. Eight years later Ross (1957) stated that the apparently uniflagellate cells of 19 species he studied possess a second, extremely short flagellum which is usually appressed to the cell membrane of the swarm cell. Cohen (1959) reopened the subject of flagellation at the 9th International Botanical Congress. His electron micrographs of whole swarm cells showed but a single flagellum in many of the swarm cells examined. Cohen demonstrated the presence of flagellum-like pseudopodia originating at the base of the true flagellum and expressed the belief that these structures may have been mistaken for flagella by other workers. He did not deny that some species or strains typically may possess biflagellate swarm cells, but insisted that flagellation is not the same for all species.

The examination of thin sections of swarm cells of Stemonitis nigrescens, Comatricha laxa, Physarum flavicomum, and Didymium iridis examined by Aldrich (1967, 1968) under the electron microscope unmistakably revealed a second short recurved flagellum. Thus, in spite of conflicting reports, there is very convincing evidence, both from the optical and electron microscope, indicating that myxomycete swarm cells are typically biflagellate. Kerr (1960) in a study of flagellation of Didymium nigripes made the very interesting observation that "Newly flagellated cells at first possess a single flagellum, $10~\mu$ long. Cells which have been flagellated for several hours often have 2 flagella." This may be a partial explanation for the apparently discordant reports.

Indira (1966) reported that the plasmodium of Arcyria cinerea when placed in water may cut off swarm-cells either from the advancing margin or from the veins and submitted evidence that this may also be done by the plasmodia of *Physarum compressum* and *Stemonitis herbatica*. It was not determined whether such swarm-cells are haploid or diploid.

It has been recently demonstrated (Schuster, 1965; Aldrich, 1968) that myxomycete flagella, in common with those of most other organisms, are constructed on the 9+2 strand pattern.

The employment of modern techniques such as phase-contrast optics, cine-photomicrography, and electron microscopy has made it possible to observe the structure and behavior of the swarm cells better than ever before. Flagellum-like pseudopodia have been seen to originate at the base of the flagella and migrate toward the posterior end (Cohen, 1959; Koevenig, 1961); streaming cytoplasm in the swarm cells is now easily observed; and the stickiness and pseudopodial activity of the posterior end have been adequately demonstrated. The swarm cells are uninucleate, with the nucleus in the anterior end just below the basal bodies.

The plasmodium. Plasmodia are commonly seen in the field, although, by reason of their way of life, less frequently than the fructifications. Those commonly observed usually belong to the Physarales. They are in the form of a network of gelatinous veins, fanning out toward a continuous advancing margin. Plasmodia may be hyaline, white, yellow, violet, red, or nearly black with various intermediate tints and shades. The color appears to be reasonably constant for a given species, but is affected by acidity or alkalinity, to some extent by light and temperature, and very commonly by material, including food, taken from the substratum.

In a few species, of which Physarum polycephalum and Physarella oblonga are conspicuous examples, the plasmodium may spend practically all of its life at the surface, feeding upon the hymenial elements of fleshy fungi and associated bacteria. In a large number of species, represented by Ceratiomyxa fruticulosa, Physarum cinereum, various species of Stemonitis, the Diacheas, and many plasmodiocarpous species, the plasmodium spends most of its time in the substratum, especially soil and decayed wood, coming to the surface only when ready to fruit. Little is known about the plasmodial habits of a very large group of Myxomycetes which includes the Liceas and most of the Cribrarias. It may be that in this group, the plasmodium as a whole never appears on the surface, but that the primordia of what are to be individual sporangia emerge as droplets and proceed to maturity singly, but often in large numbers. On the other hand, it is possible that in many of these species, especially those with minute fructifications, the plasmodium may be formed on the surface, remain minute throughout its existence, and then form but a single sporangium at the time of fruiting. This is certainly the case in three species of Echinostelium (Alexopoulos, 1960, 1961), in Clastoderma debaryanum (McManus, 1961), and in several species of Licea (unpublished data). In the great majority of the Myxomycetes, however, the plasmodium probably spends most or all of its active life within the substratum, usually dead and often decaying wood, apparently feeding on bacteria and other microorganisms in the wood and quite probably on fungus hyphae. It is admirably adapted to penetrating extremely minute pores. Moore (1933) has shown that the plasmodium of Physarum polycephalum may be induced to pass through the pores of a Berkfeldt filter, although it cannot be forced through.

Structurally, there are at least three types of plasmodia (Alexopoulos, 1961). The most common, best known, and most generally encountered type is the *phaneroplasmodium*, characteristic of the order Physarales. This takes the form of a robust, easily observed network of veins terminating in a fan-shaped sheet of protoplasm with a definite margin. Examination of the veins under a low power of the microscope will show that each vein consists of an outer layer in which no streaming occurs and an inner core of streaming protoplasm. The

protoplasm will flow in one direction for about sixty to ninety seconds, the flow will stop, and then the protoplasm will flow in the reverse direction. In the phaneroplasmodium, the protoplasm is very granular, the inner and outer layers of the veins distinct, the advancing, fleshy fans conspicuous, and the margin definite.

A second type of plasmodium, the aphanoplasmodium, is known only from a few species of Stemonitis, Comatricha, and Lamproderma, but most of the Stemonitaceae may be expected to conform to this type. In its actively growing stage it is hyaline and inconspicuous. It consists of a very fine network of hyphalike strands in which the protoplasm is much less granular than that of the phaneroplasmodium. In artificial culture a definite margin and advancing fans are absent in the early stages of development, the hypha-like strands often continuing unbranched for a considerable distance and terminating either abruptly, or with the formation of many short branches or vesicle-like projections. Eventually, a definite margin is formed, but seldom the sheet-like fans with streaming channels so characteristic of the phaneroplasmodium. Only in the largest strands is the differentiation of inner and outer layer conspicuous, most of the veins exhibiting only a thin membrane which holds the reversibly streaming protoplasm within bounds. This type of plasmodium is never observed in nature until it masses just before fruiting. Whether it spends the major portion of its existence inside the substratum, as is generally thought, and comes to the surface at the time of fruiting, or whether it lives on the surface but, because of its structure and hyaline character, is invisible, is an interesting question.

The third plasmodial type, the protoplasmodium, is probably the most primitive. It is known from three species of Echinostelium, several species of Licea, and Clastoderma debaryanum. It is probable that it will be found in many more minute species when they are studied in culture. A protoplasmodium retains juvenile characteristics throughout its life. It never grows larger than a millimeter in diameter. It forms no vein-like strands, no reticulum, no advancing fans. It is highly granular. Its protoplasm streams slowly, inconspicuously, and irregularly. At the time of fruiting, the protoplasmodium typically produces but a single, minute sporangium.

A plasmodial type which combines some of the characters of the phaneroand the aphanoplasmodium has been described by Alexopoulos (1961) and later by McManus (1962) and by Ross (1967). This type seems to be characteristic of some of the Trichiales. As the plasmodial stages of other Myxomycetes are studied more intensively, other types will undoubtedly emerge, but it is probable that the three types described above form centers of evolution from which other types may have arisen.

Regardless of type, the plasmodium of the Myxomycetes contains many nuclei, but no trace of cell walls. It has been interpreted as a single multinucleate organism on the one hand, and, on the other, as a multicellular organism in which the cell walls have disappeared. Luyet (1940) pointed out that both of these explanations are attempts to fit the recognized facts into the cell theory, in the belief that the theory must encompass all living things. Martin (1932, 1957 and in various other publications) has suggested that Dobell's term "non-cellular" should probably apply to the myxomycete plasmodium. This is not to deny that the spores, the swarm-cells or motile units which arise from them, and the zygotes conform to the usual definition of cells.

The sclerotium. Under the influence of dessication, low temperature, lack

of food, low pH, high osmotic pressure, sub-lethal doses of heavy metals, and probably other unfavorable conditions, the phaneroplasmodium may become transformed into a hard, horny resting stage, the sclerotium. Within the sclerotium, the protoplasm becomes aggregated in small masses or macrocysts, each surrounded by a membrane (Jump, 1954). Macrocysts vary in size from 10 to $25~\mu$ in diameter, and in number of nuclei from none to about 14. These macrocysts appear to be formed by the fusion of vesicles already present in the plasmodial protoplast. Upon fusion, the vesicles contribute their membranes to the new units formed (Stewart and Stewart, 1960). Such sclerotia, when properly stored, retain their viability for one to three years and give rise to typical plasmodia when revived under favorable conditions.

Aphanoplasmodia do not develop hard, horny sclerotia. Instead, when dry conditions set in, the plasmodial veins contract and separate into microscopic droplets which encyst and form a discontinuous pattern which replicates that of the plasmodial strands. Such small cysts, the aphanosclerotia, are invisible to the unaided eye. Sporangia of certain species in the Stemonitaceae and Echinosteliaceae appear on bark placed in moist chambers within 24 hours after the bark is wet (Alexopoulos, 1964a). The most logical explanation for such rapid development is the probable presence on the bark of aphanosclerotia which, upon hydration, become reconstituted into plasmodial droplets which proceed to fruit almost immediately.

Protoplasmodia encyst in their entirety, each forming a cyst. Both aphanoplasmodia and protoplasmodia sometimes sclerotize under water for unknown reasons. In that event, they remain encysted and cannot be induced by any known method to resume their activities.

Life History and Nuclear Cycle

The endosporous species. The life history of all endosporous Myxomycetes which have been investigated follows in its gross aspects the same general pattern with only minor deviations at certain points by individual species. The spores germinate and release one to four uninucleate, haploid protoplasts. These, in water, may immediately develop flagella and become swarm-cells. On moist surfaces, where free water is lacking, they may become amoeboid. In the amoeboid phase, in the presence of bacteria which may be used for food, they may undergo successive divisions and build up large populations. In the absence of sufficient food, the myxamoebae round up and encyst. If encystment takes place in water, little can be done to cause excystment. If, however, encystment takes place on a relatively dry surface, the addition of an aqueous bacterial suspension often induces germination of the cysts and subsequent formation of flagellated cells which resume the life cycle. In the presence of free water, many of the myxamoebae eventually change into flagellated cells which continue to feed. The swarming period may last from a few hours to several days depending on the species.

When a certain critical concentration of cells has been reached, compatible myxamoebae or swarm cells behave as gametes and copulate in pairs, the swarm cells making contact at their sticky posterior ends. Whether copulation of amoebae or flagellated cells is characteristic of individual species is not certain. Ross (1957) believes that it may be, but Kerr (1961) and Koevenig (1961) have shown for *Didymium nigripes* and *Physarum gyrosum*, respectively, that either pattern may prevail.

Plasmogamy is followed by karyogamy almost immediately and diploid zygotes are formed. In agar culture, where literally thousands of myxamoebae or swarm cells are present in close proximity, the number of zygotes formed is relatively small. Myxamoebae may remain in intimate contact for a long time without fusing and may then separate; others may fuse shortly after contact has been established. What factors operate to cause this behavior is not known.

Heterothallism has now been adequately demonstrated in the Myxomycetes (Dee, 1960, 1962; Collins, 1961, 1963, Henney, 1967), but very few species have been investigated as yet in this respect. Heterothallism appears to be essentially of the bipolar type with multiple alleles known in all heterothallic species which have been investigated. It is of interest to note here that the gametes of the two mating types in *Didymium iridis* and *Physarum pusillum* were reported by Therrien (1965) to have different amounts of DNA in their nuclei. The DNA sum of the two mating types was almost exactly equal to the amount found in plasmodial nuclei.

Whether the so-called homothallic species are indeed so or whether they are apogamic, as von Stosch and his co-workers (1964) insist, is still controversial. Both homothallic and apogamic development have been demonstrated, each for a single species (Kerr, 1967; Rose, 1967).

Once the zygote is formed, it feeds and grows. Karyokinesis without cytokinesis takes place successively and transforms the zygote into a plasmodium. Nuclear divisions are synchronous within a single protoplast. Under rigidly controlled conditions this synchrony is absolute. DNA synthesis begins immediately after mitosis and lasts for one to two hours (Nygaard, Guttes, and Rusch, 1960). When microplasmodia of *Physarum polycephalum*, each with a different mitotic cycle, are permitted to fuse, the mitosis is synchronized throughout the resulting plasmodium after an adjustment period of about 7½ hours. This represents about one-half of the interphase period. Minute plasmodia fuse one with another and with zygotes with which they come in contact, thus enlarging by accretion as well as growth.

The question of heterokaryosis in the Myxomycetes is a very interesting one. Since plasmodia unquestionably fuse, all nuclei in a given plasmodium are not necessarily the descendents of a single zygote nucleus. The question is whether plasmodia with nuclei of different genetic constitution are able to fuse. The few experiments which have been conducted to answer this question argue against the wide-spread occurrence of heterokaryosis, but indicate that it does occur (Collins, 1966), Collins and Clark (1968).

When conditions which favor sporulation (see appropriate section under Physiology) prevail, the plasmodium changes into one or more fruiting bodies characteristic of the species. This transformation is accompanied by cleavage of the protoplasm into uninucleate portions which become enveloped by walls and mature into spores. Capillitial development usually coincides with the beginning of sporulation.

In heterothallic species, each sporocarp contains spores of both mating types. In addition, however, spores which behave as though they were homothallic are often present among the others.

The position of meiosis in the myxomycete life cycle is controversial, the evidence presented in the literature being contradictory. The two most prevalent views on the subject are: 1. meiosis occurs in the developing sporangium preceding spore cleavage (Wilson and Cadman, 1928, Schunemann, 1930; Wilson

and Ross, 1955; Ross, 1961; Therrien, 1965; Carroll & Dykstra, 1966) and 2. meiosis occurs in the spore soon after its formation, with all products of meiosis but one disintegrating, leaving the spore uninucleate and haploid (von Stosch, 1935, 1937; 1965; Aldrich, 1967). It is possible that meiosis does not occur at the same point of the life cycle in all species or even in all isolates of the same species. Much careful cytological work, using various techniques with the same and with different isolates of many species, is needed to resolve this very important point.

According to our present information, chromosome numbers in endosporous species of Myxomycetes appear to be large, varying from n=25 to 90 or more (Ross, 1961). In *Ceratiomyxa fruticulosa*, the only exosporous species which has been investigated, the chromosome number is n=8.

The exosporous species. The life cycle of Ceratiomyxa differs in some important details from that of the endosporous species (Gilbert, 1935). Meiosis occurs in the spore shortly after its formation so that the mature spore contains four haploid nuclei. Upon germination, the spore releases a quadrinucleate protoplast which soon elongates to form the thread stage, the significance of which is unknown. Eventually, the thread rounds up and divides into four uninucleate segments, the tetrad, which remain in close association and again divide forming an octette. The eight cells now become transformed into swarm cells. These fuse in pairs forming zygotes which develop into plasmodia. At the time of fruiting the plasmodium develops papillae from which the pillars, characteristic of Ceratiomyxa fruticulosa are formed. A thin layer of protoplasm covers the fructification. After a nuclear division, the protoplasm cleaves into uninucleate segments, the protospores, which are elevated on thread-like stalks, become enveloped by a wall, and develop into spores.

II. Physiology

Spore germination. The time required for spore germination as well as the percentage of germinating spores varies with the conditions, the age of the spores, the species, the strain, and even with the particular fruiting body (Collins, 1961). For most species investigated the optimum temperature for spore germination is 22°-30° C and the optimum pH 4.5-7.0 (Smart, 1937). Wetting and drying and extracts from various natural substrata have also been reported as favoring spore germination. Elliott (1949) working with 59 species and using specimens of various ages, some of them as old as 61 years, induced the spores of all species but one to germinate by employing sodium taurocholate as a wetting agent.

Germination is accomplished by one of two methods. Either the spore cracks open or a minute pore dissolves on the wall and the protoplast emerges. The method of germination appears to be constant for each species. Although germination of single spores is said to be more difficult than germination in mass sowings (Smart, 1937), single spore cultures of many species have been obtained, yielding, in heterothallic species, clones of myxamoebae, or, in others, proceeding to complete the life cycle.

Flagellated cells and myxamoebae. In the normal course of events, both

flagellated cells and myxamoebae are formed during the life cycle of a myxomycete. Environmental conditions seem to play an important role in determining the duration of each stage: free water induces the formation of flagella; dry conditions favor the myxamoebal stage. In artificial culture the flagellated stage may be completely suppressed, at least in some species, by germinating the spores on a moist agar surface in the absence of free water (Alexopoulos, 1960). By adding water to a culture or permitting it to dry, a shift from flagellated cells to myxamoebae and vice versa may sometimes be induced over a long period of time before zygote formation begins.

Cell division probably occurs only in the myxamoebal stage, the swarm cells withdrawing their flagella before dividing. Cell division may be accelerated by the addition of sulfhydryl to the culture medium (Blickle, 1943). The myxamoebal stage of *Didymium nigripes* may be prolonged and plasmodium formation prevented by the addition of 2% glucose or 0.2% brucine to the medium (Kerr and Sussman, 1958). However, zygote formation is not inhibited, at least by glucose (Therrien, 1966). If, in accordance with Ross's (1957) findings for *D. squamulosum*, *D. nigripes* also forms its plasmodia by aggregation and fusion of zygotes, it would appear that the presence of glucose affects zygote aggregation and thus prevents or delays plasmodial formation.

The plasmodium. The rhythmic, reversible streaming of the protoplasm characteristic of the plasmodia of most Myxomycetes is a well known phenomenon, but the motive force behind this streaming is still largely unknown. The best theory seeking to explain protoplasmic streaming involves the changes in viscosity of myxomyosin when it interacts with ATP (Kamiya, 1959). Myxomyosin is a contractile protein with a molecular weight of 6 million. Its presence as well as that of ATP has been demonstrated in the plasmodium of *Physarum polycephalum* (Ts'o et al, 1956, a, b; 1957, a, b) and the reaction of these two substances appears to be similar to that of the actomyosin-ATP system in muscle.

Streaming of the protoplasm in the plasmodium is directly related to locomotion. When the plasmodium is moving over the substratum, the total volume of protoplasm transported over a given period of time will be somewhat greater in the general direction of movement than in the reverse (Kamiya, 1950, 1959). This is obviously a simple but effective method of circulation. Polarity of the plasmodium appears to be closely associated with potassium concentration, a greater concentration prevailing in the anterior over the posterior regions of a migrating plasmodium (Anderson, 1962, 1964).

The nature of the pigments in myxomycete plasmodia has attracted the attention of a number of students but beyond the fact that many of these pigments act as indicators, changing color with changes of pH, little definite knowledge has been obtained. It has been both suggested and denied that the yellow pigments have the properties of anthracenes, flavones, pteridines, or peptids. It has also been postulated that they are photoreceptors playing an important role in the process of sporulation (Wolf, 1959).

The presence of various enzymes, vitamins, sterols, and other organic substances has been detected in the plasmodium of *Physarum polycephalum*, and the production of antibiotics by several species has been reported (Locquin, 1948; Sobels, 1950). The responses of plasmodia to various external factors such as anaesthetics, low and high temperature, gravity, light, and irradiation have been studied to some extent and considerable knowledge has been accumulated.

Sporulation. Temperature, moisture, availability of food, light, and pH are all factors which influence sporulation but the initial stimulus which induces sporulation is still unknown. Gray (1939), working with *Physarum polycephalum*, showed that temperature and pH were interrelated factors. Within certain limits, the higher the temperature, the lower the pH required for fruiting. Gray (1938, 1941, 1953) also showed that light is necessary for the fruiting of pigmented plasmodia. Daniel and Rusch (1962, a, b) working with bacterium-free cultures of *Physarum polycephalum* found that the conditions necessary for sporulation are: 1. a sporulation medium containing niacin and niacinamide or certain substitutes such as tryptophane, 2. an optimal growth age, 3. a dark incubation period of 4 days, and 4. a subsequent exposure to light of wavelengths between 350 and 500 m_m.

The biochemical changes which occur during sporulation are being investigated. A shift in oxidases apparently takes place. A higher cytochrome-oxidase activity occurs in the spores than in the plasmodium and a greater ascorbic acid oxidase activity in the plasmodium than in the spores (Ward, 1958). For a detailed discussion of morphogenesis see Gray and Alexopoulos (1968).

III. Laboratory Culture and Nutrition

Plasmodia of Myxomycetes may be brought into the laboratory from the field and may often be induced to spread and grow on artificial media. Plasmodia may be maintained for a long time in culture by feeding them oat flakes (Camp, 1937). The difficulties encountered in growing Myxomycetes in the laboratory starting with spores, have, however, plagued experimentalists for a long time. Nevertheless, much progress has been made in recent years and about 40 species-most of them in the order Physarales-have now been induced to complete their life cycles on artificial media in crude culture. Monoxenic cultures of many of these organisms may be easily established by spreading spores on an agar medium, allowing the myxamoebae issuing from the spores to migrate away from contaminating organisms, and transferring them to a suitable medium together with a suspension of a known bacterium such as Escherichia coli or Aerobacter aerogenes. Such cultures proceed to develop plasmodia which eventually sporulate. Corn meal agar, Knop's solution agar or lactose-yeast extract agar, give good results. The agar medium should be suitable for bacterial growth but not so rich as to permit the bacteria to overwhelm the slime mold.

Axenic cultures are more difficult to establish. Although a few of the early workers claimed to have grown myxomycete plasmodia in pure culture, it was Cohen (1939) who first set up rigid standards for testing purity and who obtained undoubted axenic cultures of several species. Subsequently, several workers have succeeded in purifying plasmodia by frequent transfers, use of antibiotics, etc., but few species may be maintained in bacterium-free culture for a long time. The success of Rusch and his co-workers (Daniel, Kelley, and Rusch, 1962) in growing the plasmodium of *Physarum polycephalum* in bacterium-free culture, in liquid media of known chemical composition, has made possible exact nutritional studies as well as studies on conditions necessary for sporulation.

Most species of Myxomycetes are cosmopolitan. Moisture and temperature appear to be the chief factors governing the abundance of Myxomycetes in any particular region. No known species are strictly aquatic or strictly xerophilic, but collections of Myxomycetes have been made at certain times both from bogs and from desert areas. Some species appear to be confined to the tropics or subtropics and a few to the temperate zones. Physarum nicaraguense and P. javanicum, for example, have been found only in warm climates. Hemitrichia clavata, on the other hand, appears to be limited to the temperate regions. Although the latter species has been reported from the tropics careful examination of all such specimens has proved them to be H. stipitata, a related but distinct species. A few species, such as Diderma alpinum, Lepidoderma granuliferum and Lamproderma carestiae appear to be strictly alpine or sub-alpine in their distribution.

Many species are seasonal in their fruiting. Some fruit early in the spring and cease sporulating by the middle of summer; others begin in the summer and continue until fall (Krzemieniewska, 1957). Whether this is a question of photoperiodism or a response to temperature, moisture, or some other factors is not known.

Although most species appear to be independent of the substratum on which they fruit, some show a distinct preference for one type of substratum or another. Some Badhamias, for example, most often fruit on bark of deciduous trees; some Cribrarias are partial to coniferous wood; many Didymia fruit mostly on dead leaves; most Trichias on dead wood. None of these correlations is absolute, but they occur too often to be entirely coincidental.

Although plasmodia and fructifications of Myxomycetes are particularly abundant in moist, forested areas, the spores, which are typically wind-disseminated, are present almost everywhere. By employing special laboratory techniques, slime mold plasmodia or fructifications may be developed from a great variety of materials, ranging from rain water (Pettersson, 1940) to desert debris (Evenson, 1962), representing a great variety of conditions. Many species may also be easily cultured by exposing to the wind agar plates or coated slides from which isolations may be made (Brown, Larson, and Bold, 1964).

The moist chamber technique, first introduced by Gilbert and Martin (1933), which has since been used successfully by many investigators has expanded greatly our knowledge of the geographic distribution of many species, particularly those possessing minute fructifications and, for this reason, generally overlooked in the field. By the use of this technique species hitherto considered to be rare, have been shown to be common and widely distributed.

V. Collection and Care of Specimens

Throughout the world, specimens may be gathered at the proper season in almost any locality. Beginning with the latter part of May or first of June, in the northern United States, plasmodia are to be found everywhere on piles of organic refuse: in the woods, especially about fallen rotting logs, undisturbed

piles of leaves, beds of moss, stumps, by the seeping edge of melting snow on mountain sides, by sedgy drain or swamp, or in the open field where piles of straw or herbaceous matter of any kind are decaying. In any locality the plasmodia pass rapidly to fruit, but not infrequently a plasmodium in June will be succeeded in the same place by others of the same species, until the cold of approaching winter checks all vital phenomena. The process of fruiting should be watched as far as possible, and for the herbarium material, allowed to pass to perfection in the field.

As mentioned earlier, many species, such as Licea biforis, Licea kleistobolus, Echinostelium minutum, Comatricha fimbriata, etc., often overlooked in the field because of the minute size of their fructifications, may be developed in moist chamber culture on bark taken from living trees, dead wood, decaying leaves, seed pods, conifer needles, and other plant debris. The procedure is simple. Petri dishes are fitted with 9 cm. filter paper discs and sterilized in the oven or the autoclave. The material to be cultured is placed on the filter paper, covered with sterile distilled water, and allowed to soak overnight. The water is then poured off and the cultures incubated for a week, ten days, or considerably longer. Water may be added as needed to keep the chambers moist. Plasmodia and fruiting bodies develop in a remarkably large percentage of such cultures. These may be detected under a good stereomicroscope. It should be pointed out here that mature sporangia of some species, e.g., Echinostelium elachiston, sometimes become evident within 24 hours from the time the material is placed in moist chamber. Unless such sporangia are properly dried they eventually disintegrate or are destroyed by mites or other minute animals. It is important, therefore, to begin examining cultures the day after the material is wet.

Specimens collected in the field should be placed immediately in boxes in such a way as to suffer no injury in transport; beautiful material is often ruined by lack of care on the part of the collector. Once at the herbarium, specimens may be mounted by gluing the supporting material to the inside of the cover of a small box so that the label and the specimen will be inseparable. Fruiting bodies developed in moist chamber culture should be dried very gradually after they have fully matured before mounting for storage. Boxes of uniform size and depth are most desirable. In the United States National Herbarium and in the herbaria of the University of Iowa and the University of Texas specimens are mounted in boxes $1\% \times 4 \times \%$ inches. The shallow cover, inside which the specimen is mounted, permits ready examination of the material with lens or stereomicroscope. Such boxes fit snugly in a shallow box the size of an herbarium sheet, five of which fit easily into a standard herbarium shelf. The method, while somewhat wasteful of space in the case of very small collections, is admirably suited to the great majority of collections, and permits their filing in strict order. Every care must be taken to exclude insects. A small box or glass container with paradichlorobenzene crystals placed at the top shelf of each herbarium case is an efficient remedy.

For simple microscopic examination it will be found convenient first to wet the material with absolute alcohol, then, before the alcohol has completely evaporated, add a 2–3% solution of KOH to cause the spores and other structures to assume plumpness. The KOH solution should not be stronger than this or the material will swell too much. This should be blotted off, using bits of filter paper to remove the excess, but not so as to permit the material to dry. A drop of 8%

glycerine may then be added and a cover glass mounted. For permanent slides several methods have proved useful. In using the glycerine method just described, the water in the glycerine may be allowed to evaporate either before or after the cover slip is added and then sealed. Keeping the slides free from dust while the water is evaporating is important; placing them in petri dishes is convenient. Every effort should be made to eliminate air bubbles, since when these are present, they tend to move to the vicinity of the material in the mount. When the glycerine has become concentrated, all excess should be removed and the cover may be ringed with a suitable cement. A modification of this, which gives slides which will resist handling even better, is to make the mount on a 22 mm cover slip and when the glycerine has reached proper consistency, cover it with a 15 mm circle, then invert the mount on a standard slide with regular mounting medium (Diehl, 1929). Such slides remain usable for many years. Glycerine jelly is even better than glycerine, but since it must be used warm it is less convenient. Many prefer Hantsch's fluid or Amann's medium¹ which are handled in the same way except that the slide should be heated gently. Another mounting medium which has been used with some success is Hoyer's². Specimens may be mounted directly in this medium or may first be wet with 95% alcohol to eliminate air bubbles. Hoyer's medium preparations are semipermanent. After two or three years they dry out making it necessary to remount the specimens. Non-calcareous species may be mounted directly in Turtox CMC-10 or CMC-S mounting medium, diluted with an equal quantity of lactophenol, and heated gently. Such preparations dry hard and appear to last indefinitely.

Unfortunately, none of these materials can be counted upon to preserve calcareous elements although in some species they keep fairly well. Also, in specimens mounted in any but the glycerine media, the spores tend to shrink. An ideal mounting medium has yet to be found.

Careful spore measurements are necessary for accurate identification of Myxomycetes. Such measurements should be made under the oil immersion objective but in the case of larger spores measurements should be checked under a dry lens, since pressure under oil may flatten the spores and give somewhat larger measurements. Many fructifications contain large spore-like bodies, often somewhat irregular in shape, which are the result of failure of the protoplasm to proceed to complete division. In measuring spores, these bodies must be excluded. If the spores are on the whole uniform in size, an average of ten measurements may be taken as representative of the collection. Where the spores are more variable, a larger number of measurements must be made.

1. Hantsch's fluid	
Alcohol 90%	3 parts
Water	2 parts
Glycerine	1 part

Amann's medium
Phenol 20 gms.
Lactic acid 20 gms.
Glycerine 40 ml.
Water 20 ml.

2. Hoyer's medium
Distilled H_2O S0 ml.
Arabic gum lump
Chloral hydrate
Clycerine
200 gm.
20 gm.

Soak Arabic gum for 24 hours. Add chloral hydrate and let solution stand until all material dissolves. This may require several days before the glycerine is added and the solution is ready for use.

VI. Taxonomy

There has been no general agreement in the past as to the limits of the class Myxomycetes. A number of groups of uncertain position have been regarded as related to the slime molds by some authors, but excluded by others. As late as 1950, Bessey grouped the Myxomycetes, using for them the ordinal name Myxogastrales, together with the Acrasiales, the Plasmodiophorales, and the Labyrinthulales, in the subclass Mycetozoa, class Sarcodina, phylum Protozoa. All four of these groups have received considerable attention in the past quarter century and much information concerning their morphology, life history, and physiology has accumulated through observation and experiment. Such knowledge has widened rather than narrowed the gaps among these organisms and few biologists who have studied any one or more of these groups now seriously consider them to be closely related. It is unfortunate, therefore, that the term slime molds has been used for all these groups, but it is so well established in the literature that modifying adjectives have become necessary for clarification. Thus, the Myxomycetes are the acellular (non-cellular, plasmodial, true) slime molds; the Acrasiales, the cellular slime molds; the Plasmodiophorales, the endoparasitic slime molds; and the Labyrinthulales, the net slime molds.

The Acrasiales, discovered by Brefeld (1869), but first studied as a group by van Tieghem (1880), resemble the Myxomycetes in the possession of a naked amoeboid stage, but produce neither swarm cells nor true plasmodia. The amoebae become aggregated but do not lose their identity; may, in fact, readily be shaken apart in water. In his 1967 treatise, The Cellular Slime Molds, J. T. Bonner summarized our knowledge of these organisms.

The Plasmodiophorales include several genera all parasitic on vascular plants or on fungi. They show several points of resemblance to the Myxomycetes, especially in the character of the heterokont swarm cell and its apical, whiplash flagella, and in the assimilative stage, which is a true plasmodium. On the other hand, they entirely lack the secreted sporangial wall and the capillitial threads found in most of the acellular slime molds, they form zoosporangia comparable to those of many Phycomycetes, and they are held to possess a distinctive type of nuclear division. Schroeter (1886, p. 133) erected the order Phytomyxini to contain them and his classification has been extensively followed. The tendency among more recent authors, e.g. Fitzpatrick (1930), Gäumann (1926, 1949, 1964), Sparrow (1943, 1960), and Alexopoulos (1962) has been to include them among the lower Phycomycetes or to place them in a class by themselves, the Plasmodiophoromycetes (Sparrow, 1958, Alexopoulos, 1962).

The Labyrinthulales is a curious group of organisms of uncertain position. The assimilative stage consists of spindle- or oval-shaped cells gliding on or within slime tracks or tubes which are united to form a network known as the filoplasmodium or net plasmodium to which the name net slime molds, often given these organisms, refers. The filoplasmodium is in no way comparable to the plasmodium of the Myxomycetes. *Labyrinthula minuta*, however, is said to produce multinucleate protoplasts which may be true plasmodia (Watson and Raper, 1957).

^{1.} Gäumann places the holocarpic, endobiotic Phycomycetes with naked thalli in the class Archimycetes, in which he includes the Plasmodiophoraceae.

Very recently Olive (1964, 1967) and Olive and Stoianovitch (1966 a, b, c, d) have described a new order of Mycetozoa, the Protostelida, in which they have placed several species of their newly described genera, including Cavostelium, Protosteliopsis, and Schizoplasmodium. The Protostelida exhibit some of the characters of the Myxomycetes, but cannot, at the moment, be included in this group. All produce extremely minute fruiting bodies with one or two spores. Cavostelium possesses amoebae which become converted into anteriorly flagellated cells. It produces uni- or bispored (rarely more) fruiting bodies, but forms no plasmodia. The other two genera produce spores, amoebae, and plasmodia, but no flagellated cells. In Schizoplasmodium the spores behave as ballistospores. Gametic fusion has not been observed in any of the Protostelida.

In 1932 Martin presented his views regarding the fungal relationships of the Myxomycetes and, in his 1949 treatment of the Myxomycetes in North American Flora, placed this class in the division Fungi. In 1961 he reiterated his position regarding the phylogeny of the group and strengthened his views by citing new evidence which had been obtained in the interim. Thus, as here presented, the Myxomycetes are regarded as constituting the only class of the sub-division Myxomycotina, division Mycota (Fungi), coordinate in rank with the Phycomycetes, Ascomycetes, and Basidiomycetes of the sub-division Eumycotina. Certain members of the group have been noted by careful observers for over three hundred years. Lister (1925) cites Pankow's figure and description, 1654, of the species now known as Lycogala epidendrum. Ray, in 1660, called the same species Fungus coccineus, etc.; Ruppenius, in 1718, Lycoperdon sanguineum, etc.; Dillenius, a year later Bovista miniata; Buxbaum, in 1721, Lycoperdon epidendron. In 1729, Micheli erected the genus Lycogala for it and at the same time added recognizable descriptions and illustrations of several other genera and even species. But Micheli's light was too strong for his generation. As Fries, writing a century later, says "immortalis Micheli tam claram lucem accendit, ut successores proximi eam ne ferre quidem potuerint." Notwithstanding Micheli's clear distinctions, he was entirely disregarded and Lycogala was dubbed Lycoperdon and Mucor down to the end of the century. It was not until 1794 that Persoon came around to the standpoint of Micheli and wrote Lycogala "miniata" although Adanson had adopted the generic name in a somewhat uncertain application in 1763. Fries himself, reviewing the labors of his predecessors, grouped the slime molds as a suborder of the Gasteromycetes, although clearly recognizing the peculiar character of their assimilative phase, and gave expression to his view of their nature and position when he named the suborder Myxogastres. In 1833, Link, perceiving more clearly the distinctness of the group, substituted the name Myxomycetes. Wallroth used the name in the same year and he is usually credited with it, but he seems strangely to have confused its limitations, apparently regarding it as a synonym for the Gasteromycetes of Fries. Link's usage passed unchallenged for over a quarter of a century. The slime molds were set apart by themselves; they were fungi without question and, of course, plants.

In 1858 de Bary published the first of his noteworthy studies upon the Myxomycetes, based upon careful observation of their life cycles and particularly upon the transition between the plasmodial and fruiting stages. These studies were greatly amplified in 1859 and 1864. As a result of his investigations de Bary concluded that the relationships of the slime molds were with the

amoeboid protozoa rather than with the fungi, and to emphasize his viewpoint, proposed the name *Mycetozoa*—fungous animals.

In 1884 he modified the group so as to include not only the Myxomycetes of Wallroth, but the Acrasiées of van Tieghem. De Bary's name for the group has, with varying limitations, since been adopted by many distinguished authorities, including Rostafinski, Saville Kent, Zopf, the Listers, Lankester, and Hagelstein.

More recently Copeland (1956), recognizing the Kingdom Protoctista, divided it into 8 phyla of which the Protoplasta include 5 classes, among them, the Mycetozoa and the Sarkodina. The former consists of three orders, two of which are made up of the Myxomycetes and the third of which consists of the Plasmodiophorales designated by Copeland as Phytomyxida. In the latter class Copeland places the Labyrinthulales, as the family Labyrinthulida, and the Acrasiales, as the family Guttulinacea, together with 5 families of amoebae, in the order Nuda.

A more recent general taxonomic treatment which includes the slime molds is that proposed by Jahn and Bovee (1965). These authors divide the Sarcodina into two classes, on the basis of the mechanism of movement: The Autotractea "with slender, filamentous pseudopods in which two-way streaming of cytoplasm is detectable" and the Hydraulea "with tubular or polytubular body and pseudopods in which the gel tube contracts to drive the more fluid inner contents." The cellular slime molds are placed in the former, in the order Acrasida; the true slime molds (Myxomycetes) are placed in the latter, in the order Mycetozoida. The Labyrinthulales and the Plasmodiophorales are not mentioned. Finally, Whittaker (1969), using a 5-kingdom system, places the Myxomycetes in the phylum Myxomycota alongside the phyla Acrasiomycota and Labyrinthulomycota in the subkingdom Gymnomycota of his kingdom Fungi.

Whatever the position of the slime molds among living organisms may finally be determined to be, their actual study had been left almost entirely to the botanists, and particularly to the mycologists, until recent years when biochemists, biophysicists, and geneticists recognized the importance of the Myxomycetes as tools in the study of fundamental biological processes, such as nuclear division, DNA synthesis, morphogenesis, protoplasmic streaming, etc. The taxonomy and nomenclature of the group continue, however, to remain within the domain of the mycologists. By vote of the International Botanical Congress of Vienna (1905), accepted by all subsequent congresses, the nomenclature of the group is fixed as beginning with Linnaeus' Species plantarum of 1753. Linnaeus, to be sure, knew little about the fungi or slime molds, and apparently cared less. Nevertheless, the fixing of this date permits taking into account the work of a number of active students of this group dating from the closing years of the 18th century. Chief among these is perhaps Bulliard, in whose extensive work "Histoire de Champignons de la France" (1791) may be found a number of recognizable descriptions and illustrations of slime molds, unexcelled up to that time. Noteworthy references to certain species were published still earlier between 1753 and 1791 by Gleditsch (1753), Schaeffer (1762–1774), Müller (1777), Batsch (1783–1789), Leers (1789) and others. Since that time a host of students has given more or less attention to the group, of whom the outstanding names up to the time of Rostafinski are Hoffmann,

Schrader, Sowerby, Persoon, Fries, Ehrenberg, Link, Fuckel, Schweinitz, Berkeley, Curtis.

The greatest taxonomic advance since Fries is embodied in the monographic treatment of Rostafinski, whose "Versuch" of 1873 was followed by the monograph of 1874-5 and its supplement of 1876. Rostafinski, a pupil of de Bary, followed that student's example of making intensive use of the microscope, at that time, of course, greatly improved over the crude instruments at the command of earlier workers, although optically much inferior to modern apochromatic and immersion lenses. The monograph and supplement, written in Polish, were largely inaccessible to students in other countries, but were made available to English-speaking workers to a considerable extent by the works of Cooke and Berlese. In 1892 Massee published his monograph, based on Rostafinski, but departing in many particulars from his treatment, and greatly increasing the number of recognized species, not infrequently on an insufficient basis. Two years later appeared the first edition of the standard English monograph, A. Lister's "Mycetozoa," revised in 1911 and again in 1925 by his daughter, Miss G. Lister. The illustrations in this work, many of them in natural colors in the later editions, have never been surpassed in comprehensiveness and in general accuracy, and it is not surprising that European treatments in other languages have largely been modelled upon this excellent work. Most noteworthy of these is Schinz's (1920) in Rabenhorst's Kryptogamen-Flora.

In North America the first extensive collections and reports were made by Schweinitz (1822; 1832). Later active collectors were Curtis, Ravenel, Ellis, Peck, Farlow, Morgan, Rex, Wingate, Thaxter, Bethel, Sturgis and Bilgram. Cooke, in 1877, published the first general account of the slime molds of the United States, followed by that of Morgan (1893-1900). The account of the slime molds of eastern Iowa (1892, 1893) and of Nicaragua (1893) by Macbride, preceded the first edition of his North American Slime-moulds (1899). The greatly enlarged and emended second edition of this work (1922) became the basis for the Myxomycetes (1934) by Macbride and Martin. The new classification of the endosporous species into four orders, which Macbride had been developing, now became well established and has since been accepted by the majority of mycologists in the Western Hemisphere. In 1944 Hagelstein published his Mycetozoa of North America, based on the great collection of slime molds he had amassed in the New York Botanical Garden. Hagelstein adopted Lister's classification and Lister's keys from which Macbride and Martin had deviated. Volume I, Part 1, of North American Flora, dealing with the Myxomycetes was published in 1949. In this treatise, Martin followed Macbride and Martin's classification for the most part, but changed the order of treatment. The present volume is based on Macbride and Martin's monograph and on Martin's treatment in North American Flora.

In the meantime, collectors in many countries have been active in the study of the Myxomycetes, and many regional treatises have been published. The most noteworthy of these are Lodhi's Indian Slime-Moulds (1934), Hattori's Myxomycetes of Nasu District (1935), whose excellent color plates, beautifully illustrating 128 species are a fine addition to the iconography of the group, Krzemieniewska's Sluzowce Polski (1960), and the more recent treatise on the Myxomycetes of Denmark by Bjørnekaer and Klinge (1963).

The present monograph has been largely based on the Macbride-Martin Myxomycete Collection of the University of Iowa. This collection contains, in

addition to the accumulations of many years by Macbride, Martin and their colleagues and associates, the invaluable Morgan collection. Included also are noteworthy gatherings by Elliš, Farlow, Shimek, Rex, Wingate, Bilgram, Hagelstein, Harvey, Bethel, Greene, H. C. Gilbert and O. A. Plunkett in America, and Sydow, Jaap, Brândză, and Meylan in Europe and by Alexopoulos in both North America and Greece. An interesting series of duplicates of the collections of O. F. Cook from Liberia, secured by exchange with the United States National Herbarium, is also included. The study of this material has been checked by examination of that in other institutions, particularly the collection in the United States National Herbarium. Mr. Lister and Miss Lister courteously gave portions of certain critical or doubtful species to Macbride for comparison, and these are retained in the collection.

In the matter of nomenclature, the attempt has been made to adhere to the rules of the International Botanical Code. Because of the earlier starting point of the Myxomycetes (1753), as compared with the gasteromycetes (1801) and other fungi (1821–32), which has resulted in the valid publication of Myxomycetes in several genera, including *Mucor*, *Lycoperdon* and *Clathrus*, which are now used for quite different species, the application of the Code is not always clear. In other instances, where the rules permit some degree of latitude, the authors have preferred to err on the side of strictness rather than laxity. It is believed that in the long run this will be more likely to lead to nomenclatorial stabilization than the general freedom permitted, but scarcely encouraged, by the rules.

According to the Code, Art. 14, as amended at the Montreal Congress of 1959, priority in nomenclature does not apply to taxa above the rank of family. No attempt is made, therefore, to list all names which may be regarded as approximately or even strictly synonymous with orders or higher categories here recognized. An excellent list may be found in Copeland (1956) pp. 171–177. Furthermore, the names applied to groups and the relative rank assigned to them has involved terminological alterations which represent in many cases little or nothing more than orthographical changes designed to bring them into accord with contemporary usage. It seems advisable to keep such citations to a minimum.

Even at family levels, the problem is not simple. Far too many families have been proposed differing markedly in basis, range and circumscription and it is highly probable that they will be radically revised in the future. Under such circumstances, it has seemed desirable to cite names which reflect current treatments, beginning chiefly with the first edition of the Lister monograph (1894), and not to attempt an exhaustive series of citations at that level.

VII. Use of the Keys

Despite the recent advancement in knowledge of the plasmodial stage, it has not yet proved possible to use plasmodial characters extensively in classification. It is still necessary to base this almost entirely upon the characters of the fruiting stage, which is relatively constant, most commonly observed, and may be preserved indefinitely. However, because of the extraordinary sensitivity of these organisms to environmental conditions during the relatively short time in which the fructifications form, allowance must be made for this factor, which

may be reflected in size, shape, capillitial development, amount and nature of lime deposited, spore size and intensity of markings, and practically every other factor which is used in the keys. Even mature fructifications in the field may be subjected to environmental factors, notably wetting and drying, which may modify them in various ways. Despite these difficulties, most species present a fairly distinctive even though rather variable picture of what we are entitled to regard as properly referable to that category.

The distinctions between aethalium, pseudoaethalium, sporangium and plasmodiocarp are not and cannot be made sharp. Nearly all recognized species have a morphological expression which is the commonest and therefore the most characteristic form of the species concerned; practically all species which are extensively collected show wide variations in form connected by complete series of intermediates. To say that the common form is "normal" and the deviations "abnormal" is to oversimplify the situation. It is not uncommon in large fruitings which appear to have developed from a single plasmodium to find on the lower side of a log, sporangia which are provided with well-developed stalks, while those higher up have shorter stalks and those on top are sessile or plasmodiocarpous, all completely intergrading. The obvious inference is that those in the more sheltered situation have had more favorable conditions under which the fructifications have developed and that the others have formed under less favorable conditions. But the spores of all may be equally viable and the plasmodia which develop from them have all the potentialities of the parent plasmodium. The increasing use of cultural methods in recent years has emphasized this clearly (Alexopoulos, 1969).

Many species are strikingly colored, particularly when freshly formed, but even from the beginning there is great variation in this respect. Furthermore, such colors may fade or become dingy with age and then be difficult to distinguish. It is for this reason that both in the keys and in descriptions generalized color names are preferred to the more specialized terms employed in color keys.

The size, color and markings of the spores may also reflect to some extent the influence of the environment during their maturation, although in wellmatured specimens this is on the whole less evident than variation in the other features mentioned. It is, of course, a common experience to find large spore-like bodies amongst the spores. These are often quite obviously the result of overhasty drying during the maturation period and are often accompanied by other features suggesting the same thing. But even where the spores of a specific collection are all alike, they may differ in minor, but noticeable ways, such as size range, depth of color and surface markings, from those of another collection of the same species, which may have matured under different conditions. This is well brought out by examining a large series of any common and widespread species such as Ceratiomyxa fruticulosa, Fuligo septica or Arcyria cinerea. The numerous varietal names that clutter the literature are, in the great majority of cases, no more than names given to various expressions of characters which merge completely into those of the so-called "typical" forms. It is, of course, very difficult to express these variations in words which will at the same time describe a species clearly, and these difficulties quite naturally extend to the construction of keys. For that reason it has seemed desirable to key out some species more than once and occasionally to include in the keys references to

species in different genera which may, in some collections, appear to fit into the key concerned.

The keys are almost entirely dichotomous, but in some cases, where it should cause no confusion, the final choice is trichotomous.

The synonymy has been checked as fully as time and available literature has made possible, but there remain a number of names which it has not been possible to see in the original publication. It is certain that some of the references will prove to be inaccurate and that some names cited will be found not to have been validly published. It is hoped, however, that the number of such names has been substantially reduced. Many authors have published lists of species, in which certain collections were referred incorrectly to species described by earlier authors. It has been all too common to put the later authors' names after such combinations, but such attributions mean only "in the sense of" the later author. These combinations have no validity, but have been copied and recopied repeatedly. Many of them are undoubtedly included in the list of names of uncertain application following the taxonomic treatment.

VIII. Citation of Illustrations

No attempt has been made to cite all illustrations. If a species is illustrated in recognizable form when first described, such illustration is usually cited. Illustrations in certain standard works are usually cited as a matter of record, even though these works are not readily available. Thus, the illustrations in Rostafinski's Monograph, even though the work is rare, are often cited. In this instance, it may be noted that Rostafinski's 242 figures in his plates 1-12 are reproduced under the same numbers, but distributed over 23 plates, in Cooke's Myxomycetes of Great Britain. The superb illustrations in the three editions of the Lister monograph are cited only for the third edition. Most of the illustrations appear in the earlier editions, usually under different numbers and not rarely under different names. The very helpful sketches of representative species accompanying the keys to the genera in these volumes have not been cited because they are essentially simplified duplications of the plates. The excellent figures in Hattori's Myxomycetes of Nasu District, 1935, are very generally cited. The same figures, with one addition, are reproduced in the second edition of that work, 1964.

Since complete citation has not seemed possible, a high degree of selection has been inevitable. This is also true of exsiccati. Many sets are unreliable; many are difficult of access. We have found the Ellis, Ellis & Everhart, Reliquiae Farlowiani and Brândză sets very useful. Brândză apparently issued several sets with different numbers but his material is usually excellent and it has seemed worth while to cite the numbers in the University of Iowa collection and those in the New York Botanical Garden.

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Titles marked with an asterisk, representing works frequently cited in taxonomy, are included in more detail in the general bibliography.

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Class MYXOMYCETES

Synopsis of subordinate taxa recognized, in order of treatment.

Subclass CERATIOMYXOMYCETIDAE

Order CERATIOMYXALES

Family Ceratiomyxaceae Genus Ceratiomyxa, p. 33

Subclass MYXOGASTROMYCETIDAE

Order LICEALES

Family Liceaceae Genus Licea, p. 39

Family Reticulariaceae
Genus Tubifera, p. 54
Genus Dictydiaethalium, p. 59
Genus Lycogala, p. 61
Genus Reticularia, p. 66

Family Cribrariaceae
Genus Lindbladia, p. 73
Genus Cribraria, p. 75
Genus Dictydium, p. 92

Order ECHINOSTELIALES

Family Echinosteliaceae Genus Echinostelium, p. 97

Order TRICHIALES

Family Dianemaceae
Genus Listerella, p. 101
Genus Calomyxa, p. 102
Genus Minakatella, p. 103
Genus Dianema, p. 104

Family Trichiaceae
Genus Perichaena, p. 109
Genus Oligonema, p. 118
Genus Calonema, p. 120
Genus Arcyria, p. 121
Genus Arcyodes, p. 139
Genus Cornuvia, p. 141
Genus Metatrichia, p. 142
Genus Prototrichia, p. 144
Genus Hemitrichia, p. 145
Genus Trichia, p. 154

Order STEMONITALES

Family Stemonitaceae Genus Brefeldia, p. 170 Genus Amaurochaete, p. 171 Genus Elaeomyxa, p. 175 Genus Diachea, p. 176 Genus Schenella, p. 181 Genus Colloderma, p. 183 Genus Leptoderma, p. 184 Genus Diacheopsis, p. 185 Genus Enerthenema, p. 187 Genus Stemonitis, p. 189 Genus Clastoderma, p. 204 Genus Barbeyella, p. 205 Genus Macbrideola, p. 206 Genus Lamproderma, p. 209 Genus Comatricha, p. 222

Order PHYSARALES

Family Physaraceae
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Family Didymiaceae
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Taxonomic Treatment

MYCOTA

(Fungi)

Chlorophyll lacking; nutrition heterotrophic. Assimilative phase varying from a single, uninucleate or multinucleate cell to an often extensive, semi-naked, multinucleate plasmodium or to a mycelium composed of numerous branching and often anastomosing hyphae which may be continuous or septate. Reproductive phase sometimes involving the transformation of the entire assimilative thallus, but more commonly the production of specialized spore-bearing structures, these often organized into fructifications of characteristic form in which spore formation may be associated with nuclear fusion and reduction.

The Mycota may be subdivided as follows:

Assimilative stage a true, free-living plasmodium, at maturity varying from a minute, multinucleate, amoeba-like body of limited motility to a large, strongly motile mass of protoplasm flowing within netted veins and merging at the advancing margin into a continuous protoplasmic film; fructification of sporangia, either separate or united into pseudoaethalia, or of plasmodiocarps or aethalia; rarely (Ceratiomyxa) of pillar-like, poroid, or effused sporophores. Subdivision M

Subdivision MYXOMYCOTINA

With the single class.

MYXOMYCETES

Assimilative phase characteristically filamentous, with or without septa, sometimes unicellular, uni- or multinucleate, rarely plasmodium-like and then distinguished by characteristic reproductive structures.

Subdivision EUMYCOTINA

The Eumycotina includes the classes Phycomycetes (now often subdivided into several classes), Ascomycetes and Basidiomycetes and the artificial or form-classes Deuteromycetes (Fungi Imperfecti) and Lichenes.

MYXOMYCETES

Link, Handb. Gew. 3: 405. 1833 (as suborder)* Mycetozoa de Bary, Bot. Zeitung 16: 369. 1858 (as Mycetozoen).

Assimilative phase a multinucleate, free-living, acellular mass of protoplasm, the plasmodium, naked, amoeboid, varying from very small and giving rise to a single fructification, to an extensive system of branching and anastomosing veins in which the active protoplasm is enclosed in an amorphous gelatinous sheath with the anterior advancing portion naked; usually immersed within the interstices of wood, bark, leaves, dung, soil, or litter and emerging to the surface before or at the time of fructification and capable of movement within or on the substratum, less commonly superficial from the first. Reproductive phase characterized by spores or spore-like cysts, in the first subclass borne on individual stalks, in the second in the interior of spore cases, these seated on a horny, spongy, or calcareous base, the hypothallus. Spores, on germination, giving rise to one or more naked myxamoebae or flagellated swarm-cells. Under the influence of unfavorable conditions, the plasmodium sometimes fragments into a large number of disconnected cysts or becomes transformed into a horny mass, the sclerotium, consisting of multinucleate cell-like units capable of resuming plasmodial characters under favorable circumstances.

In the following treatment, the genera in each family are arranged in the order in which they appear in the keys. Within each genus, the recognized species are in alphabetical order.

KEY TO SUBCLASSES

Spores borne externally on individual stalks,
each producing on germination a naked
protoplast which develops into a cluster of
eight swarm-cells; hypothallus always well
developed, giving rise to erect, often branched,
and sometimes anastomosing extensions,
the sporophores.

Subclass CERATIOMYXOMYCETIDAE

Spores borne internally in fructifications of characteristic form, each producing on germination one or two, rarely more, swarm-cells or myxamoebae; hypothallus occasionally prominent, usually inconspicuous, sometimes imperceptible.

Subclass MYXOGASTROMYCETIDAE

^{*} Myxomycetes Wallroth, Fl. Crypt. Germ. 2: 333. 1833 (as order), appeared earlier in 1833 than Link's Handbuch, but Wallroth included gasteromycete genera in it. While Link did include a few genera not now regarded as Myxomycetes, none of them are gasteromycetes, and his grouping is therefore more in accordance with present opinion than is that of Wallroth. Myxogastres Fries, Syst. Myc. 3: 67. 1829 was published as the second suborder of his order Gasteromycetes genuini, the first suborder, Trichogastres, included mainly gasteromycetes, nearly all puffballs, and his name suggests relationships with that group. All of these names included only the endosporous forms. Since Link was the first to treat them as a distinctive group, the class name is credited to him, and Fries's name is used as the base for the subclass embracing the endogenous species only.

CERATIOMYXOMYCETIDAE

Martin, in Ainsworth, Dict. Fungi ed. 5. 497. 1961. EXOSPOREAE Rost. Vers. 2. 1873. (as Cohors).

Spores borne externally on individual spicules, these scattered over the surface of a system of usually erect, often branching and anastomosing, sometimes poroid or effused, sporophores, each spore producing on germination a protoplasmic body with four haploid nuclei, which, after mitosis, is transformed into 8 haploid swarm-cells.

The sporophores have been regarded as branches of a massive hypothallus, partly because the meiotic divisions occur in the spores, whereas the predominant evidence until recently was that meiosis occurred in the sporangium just preceding spore-formation in the endosporous forms. Recent work (see introduction) has made it clear that at least in some species of that group meiosis may occur in the spores, and it is evident that the basal portions of the fruiting structures as well as the branches, when present, must be regarded as constituting the fructification. There is often a thin, colorless layer on the substratum under the fructification, sometimes white when dusted with spores, and the use of the term hypothallus in *Ceratiomyxa* must be restricted to that membrane. Not rarely it is so difficult to see that it is scarcely apparent and sometimes appears to be completely absent.

There is a single order, family and genus. Three species are here recognized. Ceratiomyxa fruticulosa is one of the commonest and most widely distributed myxomycetes in the world, extremely variable and found nearly everywhere where slime molds have been collected. It is possible that the other two are extreme variants of this species, but on the basis of the material available, it seems proper to recognize them.

CERATIOMYXALES

Martin, N. Am. Flora 1(1): 5. 1949.

With the characters of the subclass. A single family.

Ceratiomyxaceae

Schroet., in Engl. & Prantl, Nat. Pfl. 1(1): 15. 1899.

With the characters of the order. A single genus.

Ceratiomyxa

Schroet., in Engl. & Prantl, Nat. Pfl. 1(1): 16. 1899.

Ceratium Alb. & Schw., Consp. Fung. 358. 1805. Not Ceratium Schrank, 1793.

Famintzinia Haszl., Oesterr. Bot. Zeitschr. 27: 85. 1877.

With the characters of the family.

Type species, Isaria mucida Pers.

KEY TO SPECIES

- a. Fructifications usually large, often extensive, the spores borne on erect, simple, branched or fruticose extensions, or sometimes arising directly from a resupinate or porose crust; spores smooth, sometimes globose but predominantly oval or elliptical in outline, 10–13 × 6–7 μ.
 C. fruticulosa
- a. Fructifications small or minute; spores somewhat smaller.

Fructifications scattered, each consisting of a basal stalk bearing a cluster of branches at the tip, or branches rarely sessile; spore-bearing spicules at tips of branches notably long; spores subglobose, minutely roughened, (6-)-7-9(-10) μ. C. sphaerosperma

b. Fructifications solitary or scattered, resembling Morchella in shape; spicules at tips not notably elongated; spores oval or elliptical, smooth, $9-10 \times 6-8 \mu$. C. morchella

Ceratiomyxa fruticulosa (Müll.) Macbr., N. Am. Slime-Moulds 18. 1899.

Byssus fruticulosa Müll., Fl. Dan. 4 (fasc. 12): 6. 1777.

(Tremella hydnoidea Jacq., Misc. Austr. 1: 145. 1778. (Possibly not valid)).

Clavaria puccinia Batsch, Elench. Fung. 139. 1783.

Clavaria byssoides Bull., Hist. Champ. Fr. 209. 1791.

Puccinia byssoides (Bull.) J. F. Gmel., Syst. Nat. 2: 1462. 1791.

Isaria mucida Pers., Neues Mag. Bot. 1: 121. 1794.

Ceratium hydnoides (Jacq.) Alb. & Schw., Consp. Fung. 358. 1805.

Ceratium pyxidatum Alb. & Schw., Consp. Fung. 359. 1805.

Plate I

FIG. 1

b

Ceratium porioides Alb. & Schw., Consp. Fung. 359. 1805.

Ceratium aureum Link, Ges. Nat. Freunde Berlin Mag. 7: 39. 1815.

Corynoides byssoides (Bull.) S. F. Gray, Nat. Arr. Brit. Pl. 1: 654. 1821.

Ceratium arbuscula Berk. & Br., Jour. Linn. Soc. 14: 97. 1873.

Ceratium filiforme Berk. & Br., Jour. Linn. Soc. 14: 97. 1873.

Ceratium crustosum Berk. & Curt., Grevillea 3: 62. 1874.

Famintzinia porioides (Alb. & Schw.) Haszl., Oesterr. Bot. Zeitschr. 27: 85. 1877.

Ceratium fuscum Cooke, Grevillea 8: 60. 1879.

Ceratium roseum Cooke, Grevillea 8: 60. 1879.

Ceratium sphaeroideum Kalchbr. & Cooke, Grevillea 9: 22. 1880.

Ceratium mucidum (Pers.) Schroet., Krypt.-Fl. Schles. 3(1): 101. 1885.

Ceratiomyxa mucida (Pers.) Schroet., in E. & P. Nat. Pfl. 1(1): 16. 1889.

Ceratiomyxa porioides (Alb. & Schw.) Schroet., in E. & P. Nat. Pfl. 1(1): 16. 1889.

Ceratiomyxa plumosa Atk., Bot. Gaz. 19: 337. 1894.

Ceratiomyxa hydnoidea (Jacq.) O. Kuntze, Rev. Gen. 3(3): 507. 1898. (As C. hydnodea.)

Ceratiomyxa caesia Jahn, Ber. Deuts. Bot. Ges. 36: 660. 1919.

Ceratiomyxa freyana Meylan, Bull. Soc. Vaud. Sc. Nat. 56: 65. 1925.

Fructifications white or yellowish, rarely pinkish, apricot, or bluish green, arising from a broadly effused and sometimes fertile hypothallus as clusters of erect pillars which may remain unbranched or may branch in dendroid fashion, the branches varying from few, short and thick, to very numerous, filiform and anastomosing, rarely forming a fertile crust without erect branches; total height 1–10 mm, not rarely more, spores borne externally on slender, uniform individual stalks, smooth, hyaline, variable in size and shape sometimes globose but predominantly oval or ellipsoid, $10{\text -}13 \times 6{\text -}7$ μ ; plasmodium watery, yellow or tinted with pink, apricot, or green.

TYPE LOCALITY: Europe.

HABITAT: Rotten wood, sometimes on leaves or litter.

DISTRIBUTION: Cosmopolitan, found from arctic regions to the tropics, wherever Myxomycetes occur.

ILLUSTRATIONS: Micheli, Nov. Pl. Gen. pl. 92, f. 2; Müll., Fl. Dan. pl. 718, f. 2; Alb. & Schw., Consp. Fung. pl. 2, f. 6; pl. 12, f. 9; Mem. Acad. Sci. St.-Petersb. VII. 20(3): pl. 1-3; E. & P., Nat. Pfl. 1(1): f. 7; Lister, Mycet. ed. 3. pl. 1; Hattori, Myxom. Nasu pl. 5, f. 1-2; Hagelst., Mycet. N. Am. pl. 16, f. 16.

EXSICCATI: Ellis, N. Am. Fungi 808; Ellis & Ev., Fungi Columb. 1499; Jaap, Myxom. Exs. 1, 61; Brândză, Myxom. Roum. II. 1: 1 (NY); 62 (IA); Thaxter, Rel. Farl. 384, 385.

The world-wide distribution of this common species and the variety of conditions under which fruiting occurs are reflected in the extraordinary range of forms exhibited by the mature fructification, which has resulted in the large number of specific, varietal and form names which have been applied to such variations. There is no evidence that any of them is due to more than response to local environmental conditions either during plasmodial development or at the time of fruiting and since they are all connected by a complete series of intermediate forms, even the varieties commonly recognized, of which var. flexuosa Lister for the dendroid forms, var. porioides (Alb. & Schw.) Lister for the poroid forms and var. caesia (Jahn) Lister for a bluish form, are best known, appear to designate

no more than representative examples of special types of response. The same may probably be said for the recently described var. rosella Cejp. In this species, as in others in which subspecific names have been applied to what seem to be no more than responses to environmental conditions, such names seem unworthy of recognition, but since they appear in the literature, it is sometimes convenient to refer to them. When this is done, they are listed with the publication citation.

Byssus fructiculosa Müller, 1777, appears to be the earliest legitimately published name for this species, and Macbride's combination is therefore correct. Jacquin actually wrote "quem voco TREMELLAM HYDNOIDEM" using the accusative, but Albertini and Schweinitz, in 1805, when using it as the basionym of their Ceratium hydnoides, cited it as Tremella hydnoidea Jacq.

Ceratiomyxa morchella Welden, Mycologia 46: 94. 1954.

Fructifications powdery white, each up to 3 mm tall, 0.5–2 mm in diameter, stipitate; stipe cylindrical, white or hyaline, sometimes reduced and the heads almost sessile; heads globose or subcylindrical, suggesting a miniature *Morchella*, separate or sometimes fused; hypothallus small, hyaline, membranous or absent; spores smooth, white in mass, hyaline by transmitted light, oval or elliptical, 9–11 \times 6–8 μ . Plasmodium watery, colorless.

TYPE LOCALITY: Barro Colorado Island, Canal Zone, Panama.

HABITAT: Dead wood.

DISTRIBUTION: Florida; Honduras, Costa Rica, Barro Colorado Island and Chiriqui Province, Panama; West Indies; Venezuela; Surinam.

ILLUSTRATION: Mycologia 46: 94. 1954.

This, like C. sphaerosperma, may easily be mistaken in the field for a minute or poorly developed phase of C. fruticulosa and rather robust developments do suggest small scattered fruitings of the poroid phase of that species. A collection from the mountains of western Panama, referred to C. morchella, is almost entirely effused, bearing its spores on long, curving folds.

Ceratiomyxa sphaerosperma Boedijn, Misc. Zool. Sumatr. 24: 1. 1927.

Fructifications minute, 1–2 mm in total height, scattered, loosely gregarious, usually composed of a stalk bearing a cluster of arms at the tip, these unbranched or sparsely branched, rarely sessile; spore-bearing spicules at the tips of the branches often several times as long as those on the sides; spores subglobose, slightly roughened and with granular contents, (6-)7-9 μ in diameter. Plasmodium watery, colorless.

TYPE LOCALITY: Sumatra.

HABITAT: Dead wood and plant debris.

DISTRIBUTION: Sumatra; ?Spain; Panama Canal Zone; Costa Rica; Jamaica; Brazil.

ILLUSTRATIONS: Misc. Zool. Sumatr. 24: 4; Mycologia 34: 697, f. 1.

Hagelstein (1944) suggests that this is no more than a form of *C. fruticulosa*. Its recognition from a number of scattered localities in Central America and the West Indies and the characters of the spores seem to justify regarding it as distinct. It is probably more common in the tropics than the relatively few collections suggest, this and *C. morchella* being passed over in the field as depauperate phases of *C. fruticulosa*, as noted by Welden (1954, p. 95).

A collection from Barro Colorado Island, described by Welden and provisionally

FIG. 2 Plate I

FIG. 3 Plate I assigned to this species on the basis of the small, globose spores, consists of a fertile, effused substratum with numerous scattered projections interpreted as representing the beginning of the typical erect fructifications. Boedijn's original illustration, reproduced in the Mycologia reference cited, shows a thicker stalk and fewer arms than our American material, but this is not regarded as warranting specific distinction for either form. The spores are very slightly roughened and the spore wall is thicker than in the other species. Scattered sessile clusters, bearing the characteristic small, granular spores, are assigned to this species.

DOUBTFUL SPECIES

Ceratiomyxa sphaerospora Skup., Bull. Soc. Myc. France 32: 39, f. 3., 1916. This is described as being a minute species, arising in tufts from a yellow plasmodium and with spherical spores, 3 μ in diameter. These measurements may be low, since the spores of C. fruticulosa are cited, for comparison, as 5–6 μ . All material was used up in preparing the description, and attempting, unsuccessfully, to germinate the spores, hence no specimens exist for verification.

MYXOGASTROMYCETIDAE

Martin, in Ainsworth, Dict. Fungi ed. 5. 497. 1961.

Myxogastres Fries, Syst. Myc. 3: 3. 1829 (as Suborder).

Endosporeae Rost., Versuch 2. 1873 (as Cohors).

Spores borne internally in fructifications of characteristic form, each spore producing, on germination, one or two, rarely more, swarm-cells; hypothallus various, sometimes spongy and conspicuous, usually an amorphous, horny substratum, often appearing restricted to the individual sporangia of a group, sometimes scarcely perceptible.

KEY TO ORDERS

- a. Spores in mass pallid or bright-colored, by transmitted light colorless to tinted or yellow-brown, less commonly dull black in mass and then smoky by transmitted light, never purple-brown; lime rarely secreted and then deposited on surface only. b
- a. Spores in mass usually black or dark purplish brown, by transmitted light purple-brown or brown; less commonly deep red, purple or ferruginous in mass, then often deeply tinted by transmitted light, rarely pale; lime, when present, secreted in characteristic fashion.
 - b. True capillitium lacking; pseudocapillitium, when present, of tubules or perforated plates which sometimes fray out into threads.

 Liceales
 - b. True capillitium typically present, rarely lacking, but columella then present (rarely lacking in *Echinostelium*).
- c. Stalked, minute, pale or bright-colored; columella usually present, sometimes giving rise to a capillitium in the form of a loose, open, often incomplete net; peridium delicate, very early fugacious; spores white, pinkish, yellow or ochraceous in mass.
- c. Stalked or sessile, usually relatively large; columella lacking; capillitium usually abundant, of sculptured threads; peridium usually firm, often persisting below, at least to a late stage, spores bright-colored in mass, tinted or brightly colored by transmitted light.
 - Neither peridium nor capillitium calcareous; lime rarely present and then restricted to hypothallus, base of peridium, stalk or columella.
 - d. Peridium or capillitium, or both, calcareous in normal developments.

Trichiales

Echinosteliales

d

Stemonitales

Physarales

LICEALES

Jahn, in E. & P., Nat. Pfl. ed. 2. 2: 319. 1928.

Capillitium lacking; pseudocapillitium present or absent, when present, often conspicuous; spores in mass pallid to dark, by transmitted light hyaline or subhyaline and often tinted, to smoky or yellow-brown, never purplish brown.

KEY TO FAMILIES

a. Fructification of small, often minute, sporangia, or small, simple or sparsely branched, rarely effused, plasmodiocarps; neither pseudocapillitium nor dictydine granules present; spores mostly dingy to blackish in mass, then smoky by transmitted light, sometimes bright-colored in mass, then tinted yellow or ochraceous by transmitted light.

Liceaceae

- a. Fructifications sporangiate to aethalioid, often large and conspicuous; spores pallid to variously colored but never smoky.
 - Dictydine granules lacking; usually aethalioid or pseudoaethalioid, if plasmodiocarpous or sporangiate, portions of peridium not persisting as a preformed net; spores yellow-brown by transmitted light.

Reticulariaceae

b. Dictydine granules present; mostly sporangiate, rarely united into a pseudoaethalium or an aethalium; portions of peridium in sporangiate forms persisting as a pre-formed net; spores pallid, ochraceous, pinkish or purplish, rarely yellow-brown by transmitted light.

Cribrariaceae

Liceaceae

Rost., Versuch 4. 1873 (as Tribus).

Fructifications sporangiate, sessile or stalked, or of small and unbranched or sparsely branched, rarely netted or effused plasmodiocarps; peridium varying from thin to thick, often becoming encrusted with a dark outer layer, sometimes clearly double; neither capillitium nor pseudocapillitium present; spores yellow-brown to reddish brown or blackish in mass, nearly colorless to smoky, yellow, reddish or smoky gray or olivaceous by transmitted light, often paler on one side, smooth or minutely warted or spinulose.

With the single genus Licea.

As so defined, the principal character of the family is the lack of capillitium or pseudocapillitium. Dehiscence may be by irregular breaking of the peridium above, where it is thinner, by a longitudinal slit, by the breaking away of the peridium in angular plates on preformed lines, or by separation of a lid. Various species have been segregated into separate genera on the basis of these characters, and they have recently been used by Nannenga-Bremekamp (1965a) as the basis for the erection of three subgenera, *Licea, Orcadella* (Wing.) Nann.-Brem. and *Pleomorpha* Nann.-Brem. These do not seem to us to be necessary.

Rostafinski's tribe Liceaceae included both *Licea* and *Tubulina* (*Tubifera*). The limits of the group have varied extensively and it is not intended to suggest that its restriction to the single genus *Licea* is more than a concession to current views of classification.

Licea

Schrad., Nov. Gen. Pl. 16. 1797.

Cylichnium Wallr., Fl. Crypt. Germ. 2: 267. 1833.

Protoderma Rost., Mon. 90. 1874.

Protodermium Rost. ex Berl., in Sacc., Syll. Fung. 7: 328. 1888.

Orcadella Wingate, Proc. Acad. Phila. 41: 280. 1889.

Protodermodium O. Kuntze, Rev. Gen. 867. 1891.

Hymenobolus Zukal, Oesterr. Bot. Zeits. 43: 73. 1893. Not Hymenobolus Dur. & Mont., 1845.

Hymenobolina Zukal, Oesterr. Bot. Zeits. 43: 133. 1893.

Kleistobolus Lippert, Verh. Zool.-Bot. Ges. Wien 44: Abh. 70. 1894.

With the characters of the family.

Type species, Licea pusilla Schrad.

As originally described, *Licea* included four species, two of which are now regarded as synonyms of *Tubifera ferruginosa*. Of the other two, *L. pusilla* is a typical example of the genus as at present delimited. *L. variabilis* is also recognized essentially in its original application, but in its relatively large size and marked pulvinate to plasmodiocarpous habit, suggests *Perichaena*, lacking only elaters. It is also the only species of *Licea* known to possess a well-developed phaneroplasmodium. Occasional fruitings of *Perichaena chrysosperma* in which elaters are lacking or very sparse, approach the pulvinate forms of *L. variabilis* very closely.

The various segregates which have been given generic rank are based on single characters which are often distinctive but tend to be inconstant. With the recent discovery of additional species, several not yet described, it may prove to be desirable to recognize some of them.

The recent treatment of the genus by Nannenga-Bremekamp (1965) has been most useful, although on the basis of material studied, it has not been possible to accept all of her conclusions.

KEY TO SPECIES

a. Fructifications sessile, sometimes
with restricted base but never stalked.
a. Fructifications typically stipitate, rarely sessile
and then usually accompanied by stalked sporangia.

b. Dehiscence circumscissile by a preformed lid.

b. Dehiscence not circumscissile by a preformed lid.

c. Sporangia bright coppery brown, with prominent tubules on inner portion of lid.

L. kleistobolus

c. Sporangia dark, not coppery, without tubules on inner portion of lid.

d. Sporangial wall dark gray or dingy black, gelatinous when moist, drying black and shrivelled; lid morphologically distinct.

 d. Sporangial wall dark brown, becoming black, not gelatinous; lid represented by upper plate, not morphologically distinct from lateral plates.

L. belmontiana

L. parasitica

h

q

c

e.		dium black, shining, 2-lobed by a vertical suture;	
		es bearing prominent fugacious spines.	L. fimicola
e.	Spor	rangia not spindle-shaped, rarely higher than wide; es or warts on spores not fugacious except in <i>L. chelonoi</i>	
	f.	Predominantly plasmodiocarpous, often branched, netted or effused, but varying to pulvinate; robust,	
		the plasmodiocarps sometimes attaining 10 mm or more in extent.	L. variabilis
	f.	Predominantly sporangiate or sometimes forming simple or sparsely branched plasmodiocarps rarely exceeding	a
~	Dob	1.5 mm in length. uiscence by a longitudinal, rarely forked, slit.	g h
g.		j	
g.	h.	siscence not typically by a longitudinal slit. Sporangia yellow-brown, darker below, elongate, 0.2–1.5 mm long, laterally compressed, sometimes sinuous arcuate or slightly branched, forming simple plasmodiocarps; dehiscence by a preformed slit.	
	h.	Sporangia not laterally compressed, rarely attaining 0.4 mm in length; dehiscence by a longitudinal but not obviously preformed slit.	i
i.	coa	rangia pulvinate, depressed, sessile on a broad base and counded by a dark rim; peridium thin, yellow-brown, ted by a slimy layer impregnated with dark granular terial, drying black.	L. marginata
i.	Spo nota	rangia pulvinate on a broad but restricted base, not ably depressed, shining yellow-brown, without slime and surrounded by a dark rim.	L. pumila
	j.	Peridium marked by prominent ridges dividing it into angular platelets; dehiscence by separation of platelets, especially above.	k
	j.	Ridges on peridium obscure or lacking; dehiscence usually irregular	o
k.		estnut to bright brown, tardily becoming dark; spores e yellow-brown, smooth or nearly so, 9–11 μ .	L. castanea
k.	Dark brown to umber, quickly darkening; spores distinctly sculptured.		
	1.	Platelets small, numerous; spores gray by transmitted light, with a conspicuous pale area, 11–13 μ .	L. testudinacea
	1.	Platelets large, relatively few; spores not gray.	m
m.	by	ll black, sessile on a restricted base; spores pale reddish transmitted light, strongly warted, the warts somewhat gacious, $15-18 \mu$.	L. chelonoides
m.		ark brown, or, if black, then shining; spores minutely rted to nearly smooth, the warts not fugacious.	n
	n.	Pulvinate on a broad base, umber to dark reddish brown spores reddish brown to dull ochraceous in mass, sometimes paler on one side, $10-13~\mu$.	; L. minima
	n.	Pulvinate on a somewhat constricted base, dark purplish brown to blackish; spores dark olivaceous in mass, ochraceous under lens, not notably paler on one side, mostly 15–17 μ (smaller in var. pygmaea).	L. pusilla
o.	Pla	itelets present, but obscure, rarely visible except in	,
	mi	croscopic mount; ridges obscure; peridium black, perculate, shining.	L. tuberculata

- Platelets and ridges completely lacking; peridium not tuberculate nor shining.
 - p. Sporangia bright yellow-brown at maturity, darkening only with age and deposition of material from substratum, mostly 0.1-0.3(-0.5) mm in diameter; spores 10-12 μ . L. tenera

 p. Sporangia dark brown to dull black at maturity, very minute, mostly 0.08-0.15 mm in diameter; spores 8-10 μ.
 L. punctiformis

- q. Sporangia urniform, usually operculate, 0.1-0.3 mm in diameter;
 stalk slender; total height 0.4-1 mm; spores 8-11 μ.
- q. Sporangia globose to ovate, never operculate; stalk stout.

r. Sporangia mostly 0.1-0.3 mm in diameter, stalked or rarely sessile on a constricted base; total height up to 0.6 mm; peridium composed of obscure platelets, but not netted nor ridged; spores 11-13 μ.
 L. pedicellata

r. Sporangia larger, 0.3–0.4 mm in diameter; total height up to 1.5 mm; peridium covered with a network of thickened ridges, but not divided into platelets; spores 14–15 μ.
 L. erecta

Licea belmontiana Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 69: 337. 1966.
 Sporangiate, gregarious, sessile, subglobose at first, becoming polygonal,
 50-150 μ in diameter, dark brown, somewhat shiny, the ridges slightly darker;
 paridium single brown, translucent by transmitted light, with included granules:

peridium single, brown, translucent by transmitted light, with included granules; dehiscence along preformed ridges, the margins of the plates minutely crenulate but not sculptured, the apical plate forming a lid and shed at maturity, the lower plates remaining as petaloid lobes; spores dark brown in mass, rosy brown to brown with a pale area by transmitted light, smooth, 13 μ in diameter. Plasmodium hyaline.

TYPE LOCALITY: Wageningen, Netherlands.

HABITAT: Dead bark of *Acer* in moist chamber.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATION: K. Ned. Akad. Wet. C. Proc. 69: 337, f. 1.

Said to be close to *L. pedicellata*, from which it differs in being consistently sessile in the "few hundred" sporangia which constitute the type collection. There is no evidence in our specimens of *L. pedicellata* that there is an apical plate which functions as a lid.

Licea biforis Morgan, Jour. Cinc. Soc. Nat. Hist. 15: 131. 1893. Licea sinuosa Nann.-Brem., Acta Bot. Neerl. 14: 143. 1965.

Sporangiate or plasmodiocarpous, scattered or more commonly densely gregarious, sessile on a constricted base, fusiform, somewhat compressed, occasionally branched, sinuate or arcuate, (0.2-)0.3-0.8(-1.5) mm long, 0.1-0.3 mm wide, rarely smaller or longer; walls firm, thin, smooth, opaque, at first glossy yellow-brown, with minute scattered granules on the inner surface, becoming darker with age and more or less covered by dark incrustations; dehiscence by a preformed longitudinal fissure, dividing the peridium into two equal parts, which spread widely, but remain attached at the base; spores yellow-brown or brown in mass, clear yellow by transmitted light, minutely roughened, globose, 9-12(-15) μ in diameter, or ovate and then proportionately longer and narrower. Protoplasmodium watery white, becoming brown.

FIG. 4
Plate I

p

TYPE LOCALITY: Preston, Ohio.

HABITAT: Dead bark, especially the inner side while still attached to wood; also on leaves in moist chamber.

DISTRIBUTION: New York and Pennsylvania to Florida, Ontario and Texas; Jamaica; Netherlands, Poland, Greece; eastern Asia; west Africa.

ILLUSTRATIONS: Jour. Cinc. Soc. Nat. Hist. **15**, pl. 3, f. 1; Lister, Mycet. ed. 3. pl. 149, g-k; Macbr. & Mart., Myxom. pl. 15, f. 375, 376; Univ. Iowa Stud. Nat. Hist. **14**(8): pl. 6, f. 46; Acta Bot. Neerl. **14**: 143, f. 9; 144, f. 10.

Under a hand lens, this species bears a striking resemblance to a minute hysteriaceous fungus. Its color makes it extremely inconspicuous, especially as seen against the outer bark on which it not infrequently develops in moist chambers. It is easier to see against the smoother background of inner bark and that may have something to do with its more frequent collection from that substratum. The elongate fruitings, especially when branched or arcuate, are distinctly plasmodiocarpous. The slit is sometimes lacking, usually, it appears, in sporangia which have not attained full maturity.

In describing *L. sinuosa* as distinct from *L. biforis*, Nannenga-Bremekamp cites differences in size, shape and peridium and notes that these differences are not covered in the published descriptions. That is true, but examination of our material shows the characters she stresses in various collections, and there seems to be no clear line of demarcation between the two species. The preceding description attempts to accommodate such variation.

The protoplasmodium has been cultured by McManus (1964, 1966) and by Wollman and Alexopoulos (1967). Some of the plasmodia are large and give rise to two fructifications and in this respect, as in protoplasmic movement, approach phaneroplasmodia. Wollman and Alexopoulos find the spores in some strains larger than had been previously reported.

Saccardo, in Syll. Fung. 11: 467. 1895, wrote the specific epithet "hiformis" and this has occasionally been used by others.

Licea castanea G. Lister, Jour. Bot. 49: 61. 1911.

Sporangiate to subplasmodiocarpous, scattered, sessile, round-pulvinate to elongate, 0.1–0.9(-1.3) mm long, 0.1–0.4 mm wide, at first chestnut or pale brown, becoming blackish brown with age; smooth or wrinkled; sporangial wall somewhat cartilaginous, nearly colorless or pale brown, often overlaid by a more or less continuous layer of dark granules; dehiscence along definite preformed sutures forming plates or stellate lobes whose margins are often marked with a row of minute warts about 1 μ in diameter; spores pallid to brown in mass, pale yellow to pale brown by transmitted light, smooth or nearly so, paler on one side where the walls are thinner, (8-)9-11(-12) μ in diameter. Proto-

plasmodium hyaline, then brown.

TYPE LOCALITY: Scotland.

HABITAT: Inner bark of trees or dead wood.

DISTRIBUTION: Scotland, Netherlands, Switzerland, Czechoslovakia, Greece; Massachusetts, New York, New Jersey, Kentucky, Michigan, Indiana, Illinois, Kansas, Louisiana.

ILLUSTRATION: Lister, Mycet. ed. 3. pl. 219, e-g.

Our American collections are all round-pulvinate, rarely exceeding 0.25 mm in diameter. An excellent Swiss collection from Meylan shows a number of elongate

FIG. 5 Plate I fruitings, the largest 1.3 mm long. In moist chamber developments, the sporangia mature very slowly and if left in the chambers sufficiently long they tend to become darker, appearing almost black under low magnification. Cejp (1963) reports it as occurring on moist drying papers and pressed plants in an herbarium.

Licea chelonoides Nann.-Brem., Acta Bot. Neerl. 14: 136. 1965.

Sporangia gregarious or scattered, dull black, sessile on a restricted base without apparent hypothallus; 0.5–0.8 mm in diameter, circular to elongated, 0.2–0.5 mm tall; peridium double, thick, the walls adherent; dehiscence by division into angular plates breaking along preformed lines, the basal segments persistent, remaining as petaloid lobes; spores dark brown in mass, pale redbrown or rosaceous by transmitted light, the wall paler on one side, densely or sometimes sparsely or unevenly covered with rather large, more or less fugacious warts, (14-)15-18(-19) μ in diameter. Plasmodium at first brown, then yellow, through reddish to black.

TYPE LOCALITY: Doorwerth, Netherlands.

HABITAT: Decaying wood of both conifers and angiosperms.

DISTRIBUTION: Known only from the type locality. ILLUSTRATION: Acta Bot. Neerl. 14: 137, f. 5.

This seems to be a distinctive species. We have seen no material, hence the above description is an abridgement of the original. The large spores recall those of *L. pusilla*; the fugacious warts on them, the spines on the spores of *L. fimicola*.

Licea erecta Thind & Dhillon, Mycologia 59: 463. 1967.

Sporangia scattered, stipitate, ovate or oblong, dark brown, up to 0.4 mm in diameter and 0.6 mm in height, the total height up to 1.5 mm; peridium tough, thick, persistent, brown with dark granular inclusions, the upper portion bearing an irregular network formed by thick anastomosing ridges which are continuous with those of the base and stalk, dehiscence irregular, apical; stalk one-half to two-thirds of total height, dark, erect, rigid, opaque, relatively thick, cylindrical or tapering upwards, up to 0.9 mm tall and 0.2 mm wide, arising from a basal hypothallus marked by radiating lines; spores pale ochraceous in mass, hyaline, pale by transmitted light, nearly smooth, 14–15 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Darjeeling, India.
HABITAT: On decaying bamboo stems.
DISTRIBUTION: India; Thailand.

ILLUSTRATION: Mycologia 59: 464, f. 1.

Somewhat similar to *L. operculata*, from which it differs in its more robust habit, complete lack of an operculum, and particularly in the netted peridium which approaches that of a *Cribraria*, although there is no evidence that the peridium falls away from the interstices of the net and there is no *Cribraria* which approaches it in appearance or has such large spores.

Licea fimicola Dearness & Bisby, in Bisby, Buller and Dearness, Fungi Manit. 52. 1929.

Sporangiate, scattered, gregarious or densely clustered, shining, smooth, deep reddish purple, becoming black, spindle-shaped, laterally compressed,

FIG. 6
Plate I

erect on a constricted base, 0.1–0.5 mm high, 0.05–0.25 mm wide, sometimes oval, or rounded and pulvinate; peridium rather thick, cartilaginous, shining, smooth, dehiscence by separation of the two sides along what appears to be a preformed suture, or occasionally irregular; spores dull dark brown in mass, smoky hyaline by transmitted light, with faint pinkish contents and thick wall, bearing prominent dark fugacious spines, often in a reticulate pattern, which leave smooth areas after they have fallen; (11-)13-15(-16) μ in diameter. Plasmodium pale pink.

TYPE LOCALITY: Winnipeg, Manitoba.

HABITAT: Old dung.

DISTRIBUTION: Manitoba; Oklahoma, Colorado.

In addition to our scanty portion of the type collection, Dearness 6658, and a second somewhat less perfectly developed fragment collected by Bisby, Manit. Agr. Coll. 4047, both from Manitoba, we now have portions of two specimens from Colorado, collected by R. F. Cain, TRR38254, on rabbit dung, and TRC 37612, on cow dung, and also one from Oklahoma developed on bison dung in moist chamber by Janet Winstead. TRC 37612 is particularly noteworthy, bearing hundreds of the black sporangia in small clusters, these united into large clusters. All of these were developed in moist chambers, but 37612 could easily have been detected in the field.

Licea kleistobolus Martin, Mycologia 34: 702. 1942.

FIG. 7
Plate I

Kleistobolus pusillus Lippert, Verh. Zool.-Bot. Ges. Wien 44: Abh. 70. 1894. Not Licea pusilla Schrad. 1797.

Orcadella pusilla (Lippert) Hagelst., Mycologia 34: 258. 1942.

Sporangia gregarious, sessile, discoid, rarely subglobose, circular or ellipsoid in outline, 0.04–0.15 mm in diameter, blackish, opaque below from waste deposits, the upper margin bordered by a minute row of tubercles; operculum thin, membranous, bright coppery brown, pellucid, iridescent, with a convex center bearing on its lower surface blunt, cylindrical outgrowths, with coarse tubercles toward the margin; capillitium none; spores ochraceous in mass, very pale yellowish under a lens; smooth, but often carrying granular deposits, mostly 9–13 μ in diameter. Plasmodium emerging from wood as watery blackish brown globules; probably a protoplasmodium.

TYPE LOCALITY: Austria.

HABITAT: Dead wood and bark, especially of conifers.

DISTRIBUTION: Scotland, Austria, Poland, Greece; New York to Florida, Colorado and Texas.

ILLUSTRATIONS: Bull. Acad. Polon. 1926: pl. 20; Macbr. & Mart., Myxom. pl. 21, f. 555-558.

G. Lister, Mycetozoa ed. 2. 187, reported having examined a glycerine mount, supposedly of the type, sent to her by von Höhnel and found it to be a "nearly typical" example of *L. minima* and this statement is repeated in the third edition. This was corrected by Jarocki, Bull. Acad. Polon. 1926: 850, and later by Miss Lister, Jour. Bot. 57: 202. 1927. Apparently, von Höhnel mounted the wrong specimen.

Despite its minute size, large fruitings may be rather evident in the field because of the bright coppery gleam of the opercula. It has been collected in the field in Poland, New York and Iowa, but most of the developments have appeared in moist chambers. It is certainly a distinctive species.

The finger-like processes entering the sporangial chamber from the top have been interpreted as rudimentary capillitial threads but it seems more probable that they represent no more than elongations of the tubercles, with no discernible significance.

Licea marginata Nann.-Brem., Acta Bot. Neerl. 14: 144. 1965.

Sporangia scattered or gregarious, dark brown to dull black, depressed, pulvinate to elongated or subglobose, very small, 0.1–0.2 mm in diameter, up to three times as long as wide, total height not exceeding 0.25 mm; peridium thin, translucent, yellow-brown by transmitted light, but coated with dark granular material which usually extends around the base of the sporangium, forming a dark rim about 0.05 mm wide; dehiscence by a longitudinal slit, the walls curling inward after the spores are shed; spores in mass at first pale rose, then brown, by transmitted light very pale rose, then brown, the walls thin, minutely spinulose, 10– $13~\mu$ in diameter. Plasmodium hyaline, then brown.

TYPE LOCALITY: Wolfhaze, Netherlands.

HABITAT: On bark of living trees, developed in moist chamber, and on dead wood.

DISTRIBUTION: Netherlands; Kentucky.

ILLUSTRATION: Acta Bot. Neerl. 14: 145, f. 11.

The author says "without hypothallus." The basal marginal ring darkened by granular matter is strongly suggestive of a hypothallus, but appears to be continuous with the peridial sheath. The longitudinal slit is apparently much like that of L. biforis, but the walls incurve instead of spreading when old, and there is some suggestion of vertical dehiscence in the illustrations. The spores are very similar to those of L. biforis but the brighter, often somewhat laterally compressed sporangia and the substantially different shape and size of that species make it unlikely that L. marginata is no more than a minute phase of L. biforis. The specimen from Kentucky was collected by Dr. T. E. Brooks on the stem of a dead grape vine.

Licea minima Fries, Syst. Myc. 3: 199. 1829.

Phelonites minima (Fries) Fries, Summa Veg. Scand. 459. 1849.

Tubulina minima (Fries) Massee, Mon. 36. 1892.

Sporangiate, scattered or gregarious, sessile, pulvinate, angular, 0.1–0.4 (–0.6) mm in diameter, umber or reddish brown to nearly black; peridium opaque, with prominent ridges, breaking into angular plates along preformed sutures which follow the ridges, forming segments with dotted margins, finally widely reflexed; spores dark reddish brown in mass, paler, smoky ferruginous to olivaceous brown by transmitted light, the wall thinner and paler on one side, minutely warted, (9-)10-12(-13) μ in diameter. Protoplasmodium watery drab or gray, turning yellowish or rosaceous brown in fruiting.

TYPE LOCALITY: Sweden.

HABITAT: Dead wood, mainly of conifers; also on old fungi.

DISTRIBUTION: Widely distributed in Europe, the United States and Canada;

Panama; Uruguay; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 148, d-f; Hattori, Myxom. Nasu pl. 22, f. 1; Acta Bot. Neerl. 14: 136, f. 4.

EXSICCATI: Thaxter, Rel. Farl. 406.

FIG. 8 Plate I This species appears to have been greatly misunderstood, as may be demonstrated by reading the descriptions in the literature, particularly in the various editions of the Lister and Macbride monographs. Fries (1829) in his original description, described the spores as rubiginose. Most succeeding authors have emphasized the olivaceous tints. Martin (1949) said "reddish brown in mass" and Nannenga-Bremekamp (1965), in the most critical review of the genus to date, emphasizes the reddish color, stating it is the only species of its group with a pale ferruginous spore mass.

Some of our specimens do have a very marked red spore mass. Others grade by degrees into those in which all trace of red is lost, culminating in a series with a dingy olivaceous spore mass in which the spores are smoky under a lens and very nearly smooth. These latter forms have rather small spores, mostly 9–11 μ in diameter, smoky but much lighter on one side and very faintly warted. It is possible that they should be referred to *L. pusilla* var. *pygmaea* Meylan, and it may well be, as Meylan suggests, that this is worthy of specific recognition.

Lister and Hagelstein refer to examples with violet-brown spores. These we have not seen, and in view of the confusion which has occurred, it seems improbable that they belong here. The species develops very slowly in moist chambers and should be harvested only when the spores are fully matured.

In spore characters, both of color and size, our smoky-spored specimens are close to *L. testudinacea* Nann.-Brem., but differ in the much larger peridial platelets without the conspicuously marked border tubercles which characterize that species.

Licea operculata (Wingate) Martin, Mycologia 34: 702. 1942.

Orcadella operculata Wingate, Proc. Acad. Phila. 41: 280. 1889.

Sporangia scattered, stalked, rarely sessile, urn-shaped or subglobose, dull brown or blackish, 0.1–0.3 mm in diameter, with a membranous, yellow, iridescent or vernicose lid; total height 0.4–1 mm; stalk subcylindric, attenuate above, rough, furrowed, nearly black; spores yellowish in mass, colorless by transmitted light, globose, smooth, 8–11 μ in diameter. Plasmodium dull orange.

TYPE LOCALITY: Philadelphia, Pennsylvania.

HABITAT: Bark, less commonly on leaves.

DISTRIBUTION: Maine to Florida, Central America and the West Indies, west to Minnesota and Iowa; Uruguay; Europe; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 149, d-f; Hattori, Myxom. Nasu pl. 14, f. 1.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2497.

Occasionally, the lid is lacking, but in all specimens we have examined in which that is the case, they have been accompanied by sporangia with lids. As is the case with other Liceas, most of our specimens have appeared in moist chambers. The bark from living trees of the common red oak *Quercus rubra* L., not in general a favorable substratum for Myxomycetes, has produced this several times.

Licea parasitica (Zukal) Martin, Mycologia 34: 702. 1942.

FIG. 10 Plate I

FIG. 9 Plate I

Cylichnium operculatum Wallr., Fl. Crypt. Germ. 2: 268. 1833.

Hymenobolus parasiticus Zukal, Oesterr. Bot. Zeits. 43: 73. 1893.

Hymenobolina parasitica (Zukal) Zukal, Oesterr. Bot. Zeits. 43: 133. 1893.

PLicea singularis Jahn, Ber. Deuts. Bot. Ges. 36: 665. 1919.

Orcadella parasitica (Zukal) Hagelst., Mycologia 34: 258. 1942.

Orcadella singularis (Jahn) Santesson, Sv. Bot. Tidsk. 42: 46. 1948.

Sporangia solitary, scattered or gregarious, subglobose, pulvinate or occasionally somewhat elongated, 0.05–0.2 mm in diameter, dark brownish gray, opaque, glossy when moist, typically opening by a well-defined lid, which is smooth or areolate above, minutely papillate within, or, when the lid is lacking, by apical and irregular dehiscence; wall thick, gelatinous, minutely papillose within, the lower portion thickly charged with refuse matter; spores brown in mass, subglobose, thick-walled, smooth, by transmitted light smoky yellowish brown on one side, pallid on the other, 11–13(–16) μ in diameter; plasmodium watery gray.

TYPE LOCALITY: Austria.

HABITAT: On lichens and algae and on the bare bark of trees.

DISTRIBUTION: Great Britain; Sweden; central Europe; Vermont to West Virginia, Iowa, Arkansas, and Texas, probably throughout temperate North America.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 217, h-k; Macbr. & Mart., Myxom. pl. 16, f. 397, 398; Sv. Bot. Tidsk. 42: 47, f. 2.

Zukal's specific epithet was chosen because the species was supposed to be parasitic on lichens; Santesson (1948) believed that the slimy rosaceous mass which Zukal thought was the plasmodium was in reality Illosporium roseum, an imperfect fungus parasitic on lichens, hence Zukal's name could be regarded as a nomen confusum and invalid. Santesson therefore adopted the specific epithet of Jahn's Licea singularis in referring the species to Orcadella, following Hagelstein. Jahn based his species on two sporangia. One of these was lost and the second was largely destroyed in making microscopical preparations. Jahn's description is difficult to interpret, but it seems improbable that he was dealing with the present species. On the other hand, Santesson was, and his assignment to Orcadella is based on the presence of a lid. Even if Orcadella were to be recognized, the differences between O. operculata, which must be the type, and the present species, particularly in the character of the peridium, are such as to make the assignment of L. parasitica to the same segregated genus extremely dubious. It has seemed preferable to include both species in a broader concept of Licea. The retention of Zukal's epithet may be justified by application of the second paragraph of Art. 9 of the 1961 code. In this case it is clearly possible to eliminate the Illosporium as merely one of the fungi present on the substratum. Few, if any, Myxomycetes collected in the field are without accompanying fungi. In this view, Dr. Santesson concurs.

Both the wall and the lid are gelatinous and the apparent absence of a lid is in many cases due to the fact that in drying the lid becomes a delicate, easily detached film. Dried specimens are always shrivelled and all but unrecognizable, but if a drop of water is placed on the substratum on which they occur, they tend to regain their shape and appearance much as do tremellaceous fungi. Some of the larger spore measurements recorded in the literature may be due either to incomplete maturation of spores in the specimens examined or to confusion with other species.

Wallroth's specimens of Cylichnium operculatum are still in existence, but his specific epithet is preoccupied in Licea.

Licea pedicellata (H. C. Gilbert) H. C. Gilbert, in Martin, Mycologia 34: 702. 1942.

Hymenobolina pedicellata H. C. Gilbert, Univ. Iowa Stud. Nat. Hist. 16: 153. 1934.

Sporangia widely scattered, globose or flattened, stipitate or occasionally sessile on a constricted base, dark brown or black, 75-175(-300) μ in diameter;

FIG. 11 Plate I stipe, when present, thick, furrowed, opaque, stuffed with amorphous material, dark or the color of the substratum, 100–350 μ long, the total height rarely attaining 0.6 mm; peridium membranous, sometimes granular within, continuous with the stipe and forming a distinct wall between stipe and sporangium, on drying becoming wrinkled and breaking up into irregular plates, the ridges marking the lines of dehiscence, or more often thin, membranous, breaking irregularly; spores globose, or somewhat angular, thick-walled, dark brown in mass, yellowish or light smoky brown by transmitted light, paler on one side, faintly spinulose or nearly smooth, (10-)11-13(-14) μ in diameter.

TYPE LOCALITY: Milford, Iowa.

HABITAT: On bark from living or dead trees; developed in moist chamber. DISTRIBUTION: Illinois, Iowa, Minnesota, Kansas, Texas; Mexico; Scotland, Austria, Greece.

ILLUSTRATION: Univ. Iowa Stud. Nat. Hist. 16: 154.

The minute sporangia are even smaller than those of *L. minima*. Stalked and sessile sporangia may appear in the same fruiting, and the peridial plates are often not apparent. All of our collections appeared in moist chambers. The species is probably much commoner than the distribution suggests, but it would be unusual to find it in the field. Hagelstein regarded it as a phase of *Licea parasitica*, but there seems to be no warrant for such disposition.

In the original description, the contents of the spores are said to be "rose-tinted." Reexamination of the type collection and examination of other collections, some freshly matured, failed to show any suggestion of rose. We have rarely observed platelets in the peridium, although Nannenga-Bremekamp states that *L. belmontiana*, q.v., which has delicately delimited plates, is very close to this species.

Licea pumila Martin & Allen, sp. nov.*

FIG. 365 Plate XLI Sporangia scattered or gregarious, pulvinate on a broad but somewhat constricted base, circular to elliptical or elongate in outline, yellow-brown, darker below, the pale upper portion forming a broad longitudinal or sometimes forked area of dehiscense, (0.1-)0.15-0.2(-0.25) mm broad, up to 0.3 mm long and 0.15 mm high; peridium membranous, firm, delicately embossed with concolorous tubercles, sometimes coated, especially below, with amorphous particles from substratum; dehiscence longitudinal or forked, through the center of the pale area, the halves spreading widely or breaking into lobes but with no suggestion of preformed platelets; spores yellow-brown in mass, clear yellow by transmitted light, thick-walled, minutely roughened, subglobose, $10-12~\mu$ in

^{*}Licea pumila Martin & Allen, sp. nov.

Sporangia sessilia, pulvinata, rotunda vel oblonga, luteobrunnea, (0.1-)0.15-0.2(-0.25) mm lata, usque 0.3 mm in longitudine, item usque 0.15 mm in altitudine, dehiscentia per fissuram apicalem in partes duas aequales; peridium tubercula subtilia caelata ferens; sporae subglobosae vel ovatae, asperatae, flavae, $10-12~\mu$ diam. Plasmodium ignotum.

NEW JERSEY: Riverton, 24 July 1965, on decayed inner bark of *Populus*, Ruth M. Allen C-1916, Type, in herb. R. M. Allen and IA.

diameter, or elliptical or ovate and then proportionately longer and narrower. Plasmodium unknown.

TYPE LOCALITY: Riverton, N. J.

HABITAT: Inner bark.

DISTRIBUTION: Known only from type locality.

This is only slightly larger than *L. punctiformis*, but unlike that species the peridium is firm and does not collapse on drying. The minute tubercles on the surface are visible under high power of a binocular microscope, but are not apparent on fructifications which have been moistened and mounted. The species is apparently closest to *L. biforis* but differs from that species in its much smaller size, its pulvinate habit without any suggestion of lateral compression and the lack of a preformed longitudinal fissure. It is also close to *L. marginata* Nann.-Brem., but lacks the dark basal rim and the slimy coating of that species. Additional collections have been made from the original substratum.

Licea punctiformis Martin, sp. nov.*

Sporangia sessile, subglobose or pulvinate on a constricted base, (0.08–) 0.1–0.15 (–0.2) mm wide, rarely up to 0.3 mm in longer axis, brown, smooth, becoming darker with age, and black, flattened and rugose when dry; peridium membranous, tough, gelatinous externally, without any suggestion of platelets or ridges, pale cinnamon, but more or less incrusted and darkened, especially below, with particles of debris from substratum; dehiscence irregular, beginning at apex; spores globose or somewhat irregular, golden yellow in mass, pale yellow by transmitted light, rather sparsely warted, the warts large but concolorous and inconspicuous, 8–10 μ in diameter. Protoplasmodium at first colorless, becoming dull ochraceous before fruiting.

TYPE LOCALITY: Iowa City, Iowa.

HABITAT: On bark from living Austrian pine in moist chamber.

DISTRIBUTION: Known only from type locality.

This is the smallest species thus far described in the genus. Its development was observed over a period of about three months. The protoplasmodia and sporangia were seen only on the filter paper in the bottom of the culture dish. Several additional cultures of bark from the same tree were made later, but only one produced the *Licea*, and the material has been mislaid. However, the original culture yielded at least 300 mature sporangia with additional immature sporangia and dried protoplasmodia, hence the material is ample to demonstrate the autonomy of the species. Not only is it the smallest of the Liceas, but perhaps morphologically the simplest of the Myxomycetes, the fructification consisting of no more than a mass of spores surrounded by an undifferentiated peridium. *L. tenera* Jahn is scarcely more specialized, but does differ in its much larger size, firm peridium and larger, flesh-colored, spiny spores.

^{*}Licea punctiformis Martin, sp. nov.

Sporangia minutissima, sessilia, subglobosa, brunnea, levia, sed siccata depressa, nigra, corrugata, (0.08-)0.1-0.15(-0.2) mm diam.; peridium membranaceum, gelatinosum, pallide cinnamomeum, uniforme, in apice irregulariter dehiscens; sporae subglobosae, aureae, verruculosae, 8–10 μ diam. Plasmodium primum hyalinum, demum ochraceum.

IOWA: Iowa City, January, 1966, on bark from living Austrian pine in moist chamber, GWM 6555, Type, in herb. IA.

Licea pusilla Schrad., Nov. Gen. Pl. 19. 1797.

FIG. 12 Plate I Tubulina pusilla (Schrad.) Poir., in Lam. Encyc. 8: 131. 1808.

Physarum licea Fries, Syst. Myc. 3: 143. 1829.

Protoderma pusilla (Schrad.) Rost., Mon. 90. 1874.

Protodermium pusillum (Schrad.) Rost. ex Berl., in Sacc., Syll. Fung. 7: 328. 1888.

Protodermodium pusillum (Schrad.) O. Kuntze, Rev. Gen. 3(1): 867. 1891. Sporangiate, sessile, gregarious, globose-pulvinate on a somewhat restricted base, 0.2–1.5 mm in diameter, dark purplish brown to blackish, shining; peridium thin, dark, translucent, dehiscent from above into lobes; spores dark olive in mass, light olivaceous brown by transmitted light, densely and minutely warted, the wall thinner on one side, $(13-)15-17(-20)~\mu$ in diameter. Plasmodium watery brown or dull yellow.

TYPE LOCALITY: Germany.

HABITAT: Dead wood and bark.

DISTRIBUTION: Great Britain, Sweden, Germany, Switzerland, Poland; Vermont, Pennsylvania, Ontario, North Carolina, Iowa.

ILLUSTRATIONS: Schrad., Nov. Gen. Pl. pl. 6, f. 4; Lister, Mycet. ed. 3, pl. 149, a-c.

By the standards of his time, Schrader's description is remarkably good. It is clear that he was describing a small ("vix ½ lineae partim latum") pulvinate *Licea* with brown peridium breaking up into platelets on dehiscence with large spores nearly black in mass. This is in excellent agreement with the account of Nannenga-Bremekamp (1965) for *L. pusilla* var. *pusilla*. The variety *pygmaea* Meylan, Bull. Soc. Vaud. Sci. Nat. 58: 89. 1933, was described as very small and with smaller spores, and Meylan suggested that it might be an autonomous species. However, Nannenga-Bremekamp pointed out the continuous gradation between the typical form and the variety and that is confirmed by our material. If the variety is of doubtful validity, giving it specific status would be even less warranted. Here, as elsewhere, cultural studies are needed.

Licea tenera Jahn, Ber. Deuts. Bot. Ges. 36: 665. 1919.

FIG. 13 Plate I Sporangiate, sessile on a constricted base, globose or ovoid, (0.1-)0.2-0.4 (-0.5) mm in diameter, at first shining yellow-brown, becoming darker with age and often dull black from secondary deposits; peridium membranous, translucent, yellow-brown when free from deposits, not divided into platelets, dehiscence irregular, beginning at the apex; spores golden yellow in mass, clear yellow to golden yellow by transmitted light, smooth, usually with a thinner and somewhat paler area on one side, (9-)10-12(-13) μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Bavaria.

HABITAT: Dead wood, bark, and especially dung of herbivorous animals.

DISTRIBUTION: Germany, England, Sweden; Iowa, Kansas, Texas, Oregon, California; Mexico, Brazil.

ILLUSTRATIONS: Ber. Deuts. Bot. Ges. **36**: *pl.* 18, *f.* 4–6; Lister, Mycet. ed. 3, *pl.* 219, *f. h*–*k*.

The distinctive characters of this species are the globose shape, the smooth, membranous peridium without platelets and with apical dehiscence, and the

yellow spores. Old fruitings are darker and those on which much secondary material has been deposited are black and appear angular when dry. The angles do not represent platelets, however, since when such sporangia are wet with alcohol quickly replaced by weak KOH, they resume their subglobose shape.

The published descriptions call for a rather large, bright brown sporangium on wood. Seven collections received from Professor R. F. Cain of the University of Toronto, all of which developed in moist chambers on dung from Mexico, give a good idea of the range in color from yellow-brown to black. All are small, 0.1–0.15 mm in diameter. A single ample collection on paper which lined a dung culture in Iowa, previously unidentified, proves to be the same as these Mexican collections. The plasmodium was not observed, but the manner in which it fruited on paper, having evidently migrated from the substratum, strongly suggests that it is a protoplasmodium. While the species may occur on wood, it is evidently primarily coprophilous.

Licea testudinacea Nann.-Brem., Acta Bot. Neerl. 14: 141. 1965.

Sporangia scattered or gregarious, dark brown to black, varying from angular, subglobose on a flattened base when small, to oblate or pulvinate when larger, 0.1–0.8 mm in diameter, and 0.15 mm high; peridium dark externally, shining within, brownish yellow by transmitted light, broken into numerous small angular plates by prominent ridges which mark the lines of dehiscence, the plates characterized by densely massed knobs and pegs 5–13 μ in width on the margins; spores very dark brown in mass, gray by transmitted light, with a conspicuous pale area occupying about one-third of the surface, minutely warted, (10–)12–13(–15) μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Doorwerth, Netherlands.

HABITAT: On dead bark and wood of angiosperms, in moist chambers.

DISTRIBUTION: Known only from the type locality. ILLUSTRATION: Acta Bot. Neerl. 14: 141. f. 8.

Over 30 specimens are cited in the original description, indicating that the species is rather abundant in the type area. The species is obviously close to *L. pusilla*, from which it differs principally in the much smaller peridial platelets and perhaps, less significantly, in the very large pale area of the spores.

Licea tuberculata Martin, Mycologia 49: 439. 1957.

Sporangiate, sessile and pulvinate on a broad or less commonly constricted base; 0.2–0.7 mm in diameter; peridium black, shining, strongly tuberculate, obscurely divided into plates, dehiscence by such plates or irregular; spores globose or nearly so, smooth, thick-walled, yellow-brown in mass, pale yellowish brown under the lens, paler at one side, 9–11 μ . Protoplasmodium creamy white, turning pinkish before fruiting.

TYPE LOCALITY: Barro Colorado Island, Panama Canal Zone.

HABITAT: Dead bark and wood in moist chambers. DISTRIBUTION: Known only from the type locality. ILLUSTRATIONS: Mycologia **49**: 440, *f*. 1, *a*–*d*.

This minute and inconspicuous species would be difficult to see in the field. The type collection, which, however, was abundant, developed in a moist chamber. In microtome sections of sporangia embedded in paraffin they appear to be discoid and umbilicate below, but this is not apparent in the bases of the empty sporangia

FIG. 14 Plate I as seen from above. A second collection, developed on wood from the same locality collected two days later had been provisionally referred to *L. pusilla* var. pygmaea. On reexamination it was found to resemble the type in all respects except for the somewhat more obvious developments of the platelets especially on the larger sporangia. Reexamination of the type shows the plates to be also present on the sporangia, although very obscure. They show clearly under a microscope when the peridium is carefully mounted.

FIG. 15 Plate I Licea variabilis Schrad., Nov. Gen. Pl. 18. 1797.

Licea flexuosa Pers., Syn. Fung. 197. 1801.

Trichia variabilis (Schrad.) Poir., in Lam. Encyc. 8: 131. 1808.

Tubulina flexuosa (Pers.) Poir., in Lam. Encyc. 8: 131. 1808.

Licea alutacea Wallr., Fl. Crypt. Germ. 2: 344. 1833.

Plasmodiocarpous, elongate to annulate, 0.3–1 mm wide, 1–10 mm in length, often branching or irregular or sometimes merely pulvinate; varying in color from bright ochraceous to dull black; hypothallus well developed, dull yellow; peridium of two layers, the inner thin, membranous, transparent, iridescent, the outer typically thick, dark, opaque, sometimes thin or lacking; dehiscence irregular; spores pale olivaceous to reddish brown in mass, pallid or yellowish under a lens, globose or slightly irregular or angular, thick-walled, with a thinner area of dehiscence, minutely spinulose, $(10-)12-15~\mu$ in diameter. Plasmodium deep yellow or rose (Lister); brown-violet (McManus).

TYPE LOCALITY: Germany.

HABITAT: Dead wood, and old herbaceous stems.

DISTRIBUTION: Throughout Europe; Nova Scotia to Pennsylvania, west to Washington and Oregon; Arizona.

ILLUSTRATIONS: Schrad., Nov. Gen. Pl. pl. 6, f. 5, 6; Lister, Mycet. ed. 3. pl. 148, a-c; Hattori, Myxom. Nasu pl. 11, f. 2.

EXSICCATI: Jaap, Myxom. Exs. 16, 75, 137, 160; Hintikka, Myxogast. Fenn. 10.

Both the Lister and Hagelstein monographs use Persoon's name for this species. Persoon restricts it to plasmodiocarpous forms; Schrader shows pulvinate, slightly elongate, fruitings. Both kinds occur, usually together. Schrader's description is excellent, for the time, and there seems to be no good reason for preferring Persoon's later name on what appears to be this ground alone. Lister and Hagelstein emphasize coniferous wood as the substratum, but the species seems to be equally common on angiosperm wood and other dead litter.

Licea serpula Fries, Symb. Gast. 12. 1817, is cited by Berlese, in Sacc., Syll. Fung. 7: 404. 1888, as a definite, and in the second and third editions of the Lister monograph as a possible synonym of this species. The very brief description makes this possible; the longer one in Syst. Myc. 3: 197. 1829, makes it scarcely more so. G. Lister also cites L. schoenleinii Johow, Estud. Fl. Juan Fernandez 195. 1896, as a possible synonym. We have not seen the reference, but the description in Saccardo, Syll. Fung. 14: 838. 1899, does not suggest this species and is too incomplete to be recognizable.

EXCLUDED AND DOUBTFUL SPECIES

"Licea alba Bong." Herb., ex Berl., in Sacc., Syll. Fung. 7: 338. 1888.

Cited as a synonym of *Physarum lividum* Rost. Not *L. alba* Nees. Not validly published.

Licea artocreas Berk. & Rav., Fungi Car. 2: 82. 1853. n.v.

Cited by Berlese as synonym of Perichaena corticalis (Batsch) Rost. Possibly

same as *Perichaena artocreas* Berk. & Rav., but not so stated by the latter authors in the description of that species. If so, a synonym of *Perichaena depressa*.

Licea badia Fries, Syst. Myc. 3: 89. 1829.

Not a myxomycete. An ascomycete? Lister, ed. 3: 259.

Licea berteroana Mont., Fl. Chil. 7: 20. 1852.

Not a myxomycete. An ascomycete? See Lister, ed. 3: 260.

Licea bicolor Pers., Syn. Fung. 195. 1801.

An ascomycete, Orbicula parietina (Schrad. ex Fries) Hughes. See Hughes, 1951.

Licea brassica Skvortz., Philip. Jour. Sci. 45: 89. 1931.

Wall said to contain lime. A Diderma?

Licea brunnea Preuss, Linnaea 26: 709. 1853.

Listed, with description, by Schroet., Krypt.-Fl. Schles. 3(1): 102. 1885. Not recognizable from Schroeter's description.

Licea caespitosa Peck, "Ann. Rep. N. Y. State Mus." (ref. not located).

Cited by Berlese, Sacc. Syll. Fung. 7: 405, as possibly the same as *Physarum caespitosum* Peck. No reference is made in the description of that species to earlier publication in *Licea*.

Licea didermoides Martin, Brittonia 14: 181. 1962.

An ascomycete, Orbicula parietina.

Licea hungarica Moesz, Folia Crypt. 1: 159. 1925.

An ascomycete, probably an Orbicula.

Licea mandshurica Skvortz., Philip. Jour. Sci. 45: 89. 1931.

Peridium bearing limy plates. The figure suggests a Lepidoderma but the species is said to be without capillitium.

Licea mysorensis Agnihothrudu, Ind. Phytopath. 18: 92. 1965, f. 1.

Sporangia scattered to gregarious, up to 3 mm in diameter, bright red, then through deep brown to nearly black. Spores nearly hyaline, with large, sparsely scattered warts. Pseudocapillitium rarely present. The pseudocapillitium, as illustrated, suggests that of a *Lycogala*, and the sporangia, opening by a stellate apical pore, suggest that genus more than a *Licea*. Known from two localities in Mysore, India.

Licea nitens Schw., Trans. Am. Phil. Soc. II. 4: 259. 1832.

Cited by Lister, ed. 3. 246 as possible synonym of *Perichaena corticalis* (Batsch) Rost.

Licea olivacea Fuckel, Jahrb. Nass. Ver. Nat. 23-24: 338. 1870.

Cited as synonym of *Lindbladia versicolor* (Fries) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27–28: 68. 1873. This was not based on *Enteridium olivaceum* Ehrenb., although it has been cited as a synonym of that species. The earlier description suggests *E. olivaceum* but not the later reference.

Licea pannorum Wallr., Fl. Crypt. Germ. 2: 343. 1833.

Probably Orbicula parietina. See Hughes, 1951.

Licea quercina (Fries) Wallr., Fl. Crypt. Germ. 2: 344. 1833.

May refer to Perichaena corticalis. See Lister, ed. 3. 246.

Licea spadicea Fries, Stirp. Fems. Cont. V. 90. 1827.

Mentioned by Fries, Syst. Myc. 3: 197: "S. serpula s. spadicea Fries, Symb. Gast. p. 12." See comment under L. variabilis.

Licea spumarioidea Cooke & Massee, Grevillea 16: 74. 1888.

Not a myxomycete. Sepedonium chrysospermum according to Lister, ed. 2.

Licea sulphurea Wallr., Fl. Crypt. Germ. 2: 343. 1833.

Probably Orbicula parietina. See Hughes, 1951.

Reticulariaceae

Rost. Versuch 6. 1873 (as Tribus).

Fructification sporangiate, the sporangia densely clustered, often united into a pseudoaethalium or forming a true aethalium; pseudocapillitium usually present, in the form of simple or branched columns which appear to represent aborted sporangia, or of bristles, or simple or branched tubes or frayed or perforated membranes; spores pallid to ochraceous, olivaceous, or brown in mass, rarely yellow, hyaline or bright yellow-brown by transmitted light, never smoky.

KEY TO GENERA

a. Fructification sporangiate, sporangia clustered or united into a pseudoaethalium.

b

c

a. Fructification a true aethalium.

 Sporangiate or pseudoaethalioid with persistent sporangial walls; hypothallus massive, fibrous or spongy.

Tubifera

b. Sporangia closely appressed into a pseudoaethalium; sporangial walls disappearing at maturity except for thickened strands at the angles which persist as pseudocapillitial threads depending from the lids; hypothallus not massive or spongy.

Dictydiaethalium

 Aethalium subglobose to conical or pulvinate, often on a restricted base; pseudocapillitium of colorless, branching tubes; spores pinkish, then pallid in mass.

Lycogala

 Aethalium pulvinate on a broad base; pseudocapillitium of frayed or perforated membranes; spores brown, yellow or olivaceous in mass.

Reticularia

Tubifera

J. F. Gmelin, Syst. Nat. 2: 1472. 1791.
Tubulifera Jacq., Misc. Austr. 1: 144. 1778.
Tubulina Pers., Neues Mag. Bot. 1: 91. 1794.
Alwisia Berk. & Br., Jour. Linn. Soc. 14: 86. 1873.
Siphoptychium Rost., Mon. App. 32. 1876.

Sporangia cylindric or ellipsoid, free, or connate on a usually thick, spongy hypothallus, then often forming a pseudoaethalium, the walls membranous, persistent; dehiscence apical, capillitium lacking; pseudocapillitium present or absent, when present, as bristles arising from walls of sporangial cavity or as a more or less branching columella which may represent an abortive sporangium; spores bright yellow-brown, spiny or reticulate.

Type species, Stemonitis ferruginosa Batsch.

There can be little doubt that *Tubulifera* Jacq. was published as a valid genus in 1778, although since Jacquin did not use binomials consistently, there is some question as to whether his specific names are valid. Müller, Fl. Dan. 4(11): 8. 1775, used the name even earlier but did not supply a generic description and his brief diagnoses of the two species included cannot be regarded as constituting a combined generic and specific description, although his illustrations are clear. No useful purpose would be served by reviving *Tubulifera*.

Fries, Syst. Myc. 3: 195. 1829, reduced *Tubulina* Pers. to a "tribe" of *Licea*, including two species, both of which are now regarded as included in *Tubifera ferruginosa*.

KEY TO SPECIES

 a. Sporangia clustered in groups of 2-8 on a fibrous, branching hypothallus; pseudocapillitium composed of bristles arising from base and walls of sporangial cavity, sometimes lacking.

T. bombarda

 a. Sporangia in large, dense clusters, often connate and forming a pseudoaethalium, pseudocapillitium rarely present and then appearing like branches from a columella; hypothallus spongy, massive.

b

 Sporangia fusoid-cylindrical, mostly free, clustered on a stem-like hypothallus; spores appearing warted but showing a faint and coarse reticulation under oil.

T. papillata

 Sporangia cylindrical, densely clustered; spores clearly reticulate over most of surface.

c

c. Pseudocapillitium present, columella-like, sometimes with branches which may reach the sporangium wall.

T. casparyi

c. Pseudocapillitium lacking.

d

d. Hypothallus contracted, forming a short, thick stalk; spores under 6 μ in diameter.

T. microsperma

d. Hypothallus expanded; spores 6–8 μ in diameter.

T. ferruginosa

Tubifera bombarda (Berk. & Br.) Martin, Brittonia 13: 110. 1961.

Alwisia bombarda Berk. & Br., Jour. Linn. Soc. 14: 86. 1873.

Prototrichia bombarda (Berk. & Br.) Massee, Mon. 128. 1892.

FIG. 16 Plate II

Sporangia ovate-cylindric, pale yellow-brown to dull yellow-brown, $1{\text -}1.5 \times 0.5$ mm, stipitate, the stalks often coalescent or branching, forming clusters of 2–8 or more, arising from a widespread but delicate hypothallus; peridium evanescent above, the lower portion persisting as a cup; pseudocapillitium, when present, composed of a cluster of rigid, tubular threads arising from the interior of the cup, mostly unbranched except near the base, and protruding in brush-like fashion after dehiscence, nearly smooth or finely spinulose and often with bulbous enlargements, attached to the peridium before dehiscence, sometimes rudimentary or lacking; spores reddish brown in mass, faintly reticulate over two-thirds of the surface, 5–6 μ in diameter. Plasmodium watery white.

TYPE LOCALITY: Ceylon. HABITAT: Dead wood.

DISTRIBUTION: Ceylon, Malaya, Sumatra, Philippines; Costa Rica; Puerto

Rico; Jamaica.

ILLUSTRATION: Lister, Mycet. ed. 3, pl. 151.

The pseudocapillitium is very striking when present and was the justification for establishing the genus Alwisia. In a very ample collection from Jamaica the threads are almost lacking, although careful search reveals a few rudiments of them. In all other respects this material agrees fully with Alwisia bombarda and suggests nothing else. A specimen from Costa Rica (Lowy) has numerous bristles, while in another (Sáenz) they have mostly fallen away. In view of the apparent

inconstancy of the bristles, and their early disappearance in at least some specimens, there seems to be no point in maintaining a monotypic genus for this species on a single and inconstant character.

FIG. 17 Plate II Tubifera casparyi (Rost.) Macbr., N. Am. Slime-Moulds 157. 1899. Siphoptychium casparyi Rost., Mon. App. 32. 1876.

Sporangia angular, cylindric, brown, up to 3 mm tall and 0.4 mm wide, closely compacted into a pseudoaethalium varying in extent from 5 mm to 10 cm or more; peridium firm, persistent, iridescent, granular; hypothallus pallid, spongy, broad, rather thin; pseudocapillitium present in many sporangia as a columella-like central body, probably representing an abortive sporangium, sometimes a simple spine, more often connected with the wall by tubular processes or threads; spores umber-brown in mass, pale brown by transmitted light, unevenly reticulate over most of the surface, 7.5–9 μ in diameter. Plasmodium white, changing to dull gray, then umber.

TYPE LOCALITY: Europe. HABITAT: Dead wood.

DISTRIBUTION: Widely distributed in Europe and North America, but not common; also reported from Japan.

ILLUSTRATIONS: Rost., Mon. App. f. 245; Lister, Mycet. ed. 3. pl. 150, f-h. EXSICCATI: Ellis & Ev., N. Am. Fungi 2092; Brândză, Myxom. Roum. 23 (IA); Thaxter, Rel. Farl. 425.

The relation of this species to *Tubifera ferruginosa* may prove to be analogous to that between the phases of *Tubifera bombarda* with pseudocapillitium and those without it. However, the spores lack the smooth area at one end which is characteristic of *T. ferruginosa* and *T. microsperma*. Rostafinski's figure is highly diagrammatic but does show effectively the general plan of a representative sporangium; Lister's figure is excellent.

FIG. 18 Plate II Tubifera ferruginosa (Batsch) J. F. Gmel., Syst. Nat. 2: 1472. 1791.

(Tubulifera arachnoidea Jacq., Misc. Austr. 1: 144. 1778.) Possibly not valid. Stemonitis ferruginosa Batsch, Elench. Fung. Contin. 1: 261. 1786.

Lycoperdon favaceum Schrank, Baier. Fl. 2: 667. 1789.

Sphaerocarpus cylindricus Bull., Hist. Champ. Fr. 140. 1791.

Sphaerocarpus fragiformis Bull., Hist. Champ. Fr. 141. 1791.

Tubifera cylindrica (Bull.) J. F. Gmel., Syst. Nat. 2: 1472. 1791.

Tubifera fragiformis (Bull.) J. F. Gmel., Syst. Nat. 2: 1472. 1791.

Tubulina fragiformis (Bull.) Pers., Neues Mag. Bot. 1: 91. 1794.

Tubulina coccinea Trent., in Roth, Catalecta Bot. 1: 243. 1797.

Licea tubulina Schrad., Nov. Gen. Pl. 16. 1797.

Licea clavata Schrad., Nov. Gen. Pl. 18. 1797.

Tubulina fallax Pers., Obs. Myc. 2: 28. 1799.

Tubulina cylindrica (Bull.) DC., Fl. Fr. 2: 249. 1805.

Tubulina fragifera Poir., in Lam. Encyc. 8: 130. 1808.

Licea fragiformis (Bull.) Nees, Syst. Pilze Schw. 107. 1816.

Licea fallax (Pers.) Fries, Symb. Gast. 12. 1817.

Licea effusa Ehrenb., Sylv. Myc. Berol. 18. 1818.

Licea cylindrica (Bull.) Fries, Syst. Myc. 3: 195. 1829.

Licea iricolor Zoll., in Zoll. & Mor., Nat. Geneesk. Arch. Neêrl.-Ind. 1: 376. 1844.

Tubulina conglobata Preuss, Linnaea 24: 140. 1851.

Licea rubiformis Berk. & Curt., Proc. Am. Acad. 4: 125. 1859.

Tubulina nitidissima Berk., Jour. Linn. Soc. 18: 387. 1881.

Tubulina speciosa Speg., Atti Soc. Critt. Ital. 3: 62. 1881.

Sporangia cylindric to ovoid, to 5 mm tall and 0.4 mm wide, usually crowded and angular from pressure, forming a pseudoaethalium up to 15 cm or more in extent upon a broadly effused, never stipitate, spongy hypothallus, rarely loosely clustered, pale umber to deep reddish brown or purplish brown; peridium thin, translucent, iridescent, persistent; dehiscence apical or, when the sporangia are closely compacted, by the breaking away of their tips as lids; hypothallus well developed, cellular to spongy, colorless or pallid until colored by the spores; spores umber-brown in mass, pallid by transmitted light, globose, reticulate over about three-fourths of the surface, 6–8 μ in diameter. Plasmodium colorless on emergence, becoming milky white, then changing through rose to brown in fruiting.

TYPE LOCALITY: Germany.

HABITAT: Dead wood, leaves, or litter.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Batsch, Elench. Fung. Contin. 1: pl. 30, f. 175 a, b; Bull.,
Herb. Fr. pl. 384; 470, f. 3; Massee. Mon. pl. 1, f. 1; Lister, Mycet. ed.
3. pl. 150, a-c; Univ. Iowa Stud. Nat. Hist. 14(8): pl. 6, f. 43; Hattori,
Myxom. Nasu pl. 13, f. 5; Hagelst., Mycet. N. Am. pl. 12, f. 6.

EXSICCATI: Ellis & Ev. N. Am. Fungi 2096; Jaap, Myxom. Exs. 36; Brândză, Myxom. Roum. II. 2: 42 (NY); 22 (IA); Hintikka, Myxogast. Fenn. 20; Thaxter, Rel. Farl. 816.

While this species frequently forms rather extensive pseudoaethalia, small fruitings are often difficult to distinguish in the field from sessile phases of *T. microsperma*. However, the deeper colors of the maturing and fully matured pseudoaethalia, the generally larger size of these and especially the larger spores appear to be constant. The plasmodial colors are based on reports transmitted by Dr. Patricia Allison.

The synonymy is very uncertain. Many of the older names could be applied to either species, and some are of very doubtful application. Sprengel (1827) cites Tubulina fallax Pers. as a doubtful synonym of Licea effusa Ehrenb. but Dermodium fallax (Pers.) Nees, Syst. Pilze Schw. 109. 1817, as a definitive synonym. Reference to Nees's figure 103, A does not suggest the present species, and Lister, ed. 3 (1925) enters D. fallax as a doubtful synonym of Stemonitis splendens var. flaccida Lister, i.e., Amaurochaete ferruginea Macbr. & Martin of the present treatment. Since Nees's name was based on Persoon's and material studied by these authors has not been reexamined, no solution is possible at this time.

"Tubulifera coccinea Trent.", cited by Rost., Mon. 220. 1874, was an error, but has been copied by later authors. Trentepohl did cite Tubulifera cremor Oeder, but adopted Persoon's generic name.

Tubifera microsperma (Berk. & Curt.) Martin, Mycologia 39: 461. 1947.

Licea stipitata Berk. & Rav., in Berk. & Curt., Proc. Am. Acad. 4: 125. 1860. Not L. stipitata DC. 1815.

Licea microsperma Berk & Curt., in Berk., Grevillea 2: 68. 1873. Tubulina stipitata (Berk. & Ray.) Rost., Mon. 223. 1875. FIG. 19 Plate II Tubifera stipitata (Berk. & Rav.) Macbr., N. Am. Slime-Moulds 157. 1899.

Sporangia angular-cylindric, brown, to 4 mm tall and 0.4 mm wide, crowded into a subglobose or hemispherical pseudoaethalium, sessile or borne upon a spongy, sulcate, often stem-like hypothallus 2–6 mm tall; peridium thin, translucent, evanescent; total height to 10 mm; spores umber-brown in mass, reticulate over about two-thirds of the surface, globose, 4.5–5.5(–6) μ in diameter. Plasmodium white, becoming flesh-colored in fruiting.

TYPE LOCALITY: South Carolina.

HABITAT: Dead wood.

DISTRIBUTION: Widely distributed in temperate and tropical North America; Hawaii; South America; tropical Asia; Japan.

ILLUSTRATIONS: Rost., Mon. pl. 1, f. 2; Lister, Mycet. ed. 3. pl. 3, 150, d-e.

Even when the stalk is poorly developed, the small spores and the usually brighter and more delicate peridium distinguish this from T. ferruginosa and the plasmodium, according to Dr. Allison, is constantly paler at comparable stages when forming fructifications. Nevertheless, puzzling intermediates do occur and it is possible that this represents certain phases of T. ferruginosa.

As a later homonym of Licea stipitata DC., L. stipitata Berk. & Rav. was invalid from the first. No spores are mentioned in the description of the latter in 1860, but in Jour. Linn. Soc. 10: 350. 1868, Berkeley and Curtis describe the spores as "shaped like the seeds of a Veronica, .00929 inch long," contrasting this with the spores of L. fragiformis, described as globose and .00028 inch in diameter, i.e. 23.2μ as opposed to 7μ . If, as commonly believed, Berkeley and Ravenel's species is correctly referred to the synonymy, then the first nine in Berkeley's figure may be a typographical error. In Grevillea 2: 68. 1873, Berkeley recognizes both L. stipitata and L. microsperma, but gives no spore dimensions.

Rostafinski's figure shows an extremely robust stalk, much thicker than any we have seen. In general, tropical collections seem to have more prominent stalks than those from temperate regions, but this character is variable and in some cases both sessile and stalked clusters occur in the same group. Single sporangia also occur, but in every specimen seen they are accompanied by clusters.

Tubifera papillata Martin, Thind & Sohi, Mycologia 49: 131. 1957.

FIG. 20 **Plate II** Sporangia cylindrical, brown, narrowed at the obtuse apex, up to 3 mm tall and 0.7 mm wide, densely crowded but only slightly angular, forming a pseudoaethalium up to 7 mm broad, borne on the stipe-like hypothallus; peridium thin, membranous, shining, rupturing at the apex, the lower portion persistent; hypothallus columnar, stalk-like, dark brown, up to 3 mm in height; spores warted, with a very coarse, somewhat irregular reticulation, 6.5–7.7 μ . Plasmodium unknown.

TYPE LOCALITY: Mussoorie, India.

HABITAT: Decayed wood.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATION: Mycologia 49: 132. f. 3.

The nearly free sporangia approach the condition in *T. bombarda*, from which it is separated by the massive, stalk-like hypothallus on which they are clustered, and the somewhat larger spores, which appear papillate except under an oil immersion lens, and the complete lack of any evidence of a pseudocapillitium. In the original description these were said to be "uniformly papillate, with a very faint underlying, somewhat irregular reticulation." Reexamination of the type material, using higher powers and better illumination, shows that the spores are

somewhat irregularly warted, with a few much larger warts, and a faint but coarse and irregular reticulation. The specific epithet refers to the papillate appearance of the spores under a dry lens and is not appropriate, but cannot, of course, be changed.

EXCLUDED AND DOUBTFUL SPECIES

"Tubulifera ceratum Müller", Fl. Dan. 4(11): 8, pl. 659, f. 2. 1775.

Name perhaps invalid. Surely Tubifera ferruginosa.

"Tubulifera cremor Müller", Fl. Dan. 4(11): 8, pl. 659, f. 1. 1775.

Name perhaps invalid. Surely Tubifera ferruginosa.

Tubulina bicolor (Pers.) Poir., in Lam. Encyc. 8: 131. 1817.

An ascomycete. Probably Orbilia parietina (Schrad. ex. Fries) Hughes.

Tubulina guaranitica Roum., Fungi Sel. 5196. 1890.

A hyphomycete, G. Lister, Mon. ed. 3, 262.

Tubulina spumarioidea (Cke. & Massee) Cke. & Massee, in Massee, Mon. 42. 1892.

Based on Licea spumarioidea Cke. & Massee, q.v. Not a myxomycete.

Tubulina variabilis (Schrad.) Poir., Lam. Encyc. 8: n. 8. 1808.

Cited by Rost., Mon. 219, as a synonym of *Licea variabilis*. *Trichia variabilis* (Schrad.) Poir., in the same volume, is usually regarded as the same, but the Lister Mon. ed. 3, 183, questions it. Nomenclaturally they seem to be synonyms, but Poiret's volume has not been available.

Dictydiaethalium

Rost., Versuch 5. 1873.

Clathroptychium Rost., Mon. 225. 1875.

Ophiuridium Hazsl., Oesterr. Bot. Zeitschr. 27: 84. 1877.

Fructification a pseudoaethalium, composed of numerous cylindrical sporangia closely compacted into a palisade layer and angular by pressure, the thinner portions of the walls disappearing at maturity, leaving the thicker regions formed by the angles depending from the thickened caps of the sporangia as threads forming a pseudocapillitium, the caps united to form a continuous bullate or tessellate cortex; spores ochraceous, brown or olivaceous, less commonly red or yellow in mass, paler by transmitted light.

Type species, Reticularia plumbea (Schum.) Fries.

The fructification is commonly referred to as an aethalium. Baker (1932) showed that until maturity it is composed of closely compacted cylindrical sporangia, each with a complete wall which is thickened at the junctions. At maturity, the thinner portions of the walls disappear, leaving the thickened angular corners depending as threads from the caps of the individual sporangia and immersed in the general mass of the spores as a pseudocapillitium, the threads not reaching the base. To call this a pseudoaethalium rather than an aethalium is thus largely a matter of definition.

KEY TO SPECIES

a. Spores banded-reticulate; pseudoaethalia olivaceous; peridial caps about 60 μ in diameter.

D. dictyosporum

a. Spores warted or spinulose; pseudoaethalia usually bright yellow-brown to umber, but sometimes olivaceous; peridial caps usually exceeding 100 μ in diameter.

D. plumbeum

Dictydiaethalium dictyosporum Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 69: 344. 1966.

Fructification a pseudoaethalium, simulating an aethalium at maturity,

borne on a silvery hypothallus which extends only slightly beyond the margins, the lids of the component sporangia bullate, 60 μ in diameter, united into a thin, membranous, dull olivaceous cortex, the pseudoaethalia about 1.2 mm thick and attaining up to 13 mm in breadth; cortex translucent, olivaceous brown by transmitted light, the strands depending from the angles of the caps, flat, thickened on one side, about 8 μ broad and 1 μ thick, smooth except for a row of minute warts along the thickened side; spores olivaceous in mass, pale greenish yellow by transmitted light, globose or subglobose, incompletely banded-reticulate, the meshes small, about 9–11 μ not including the bands, 11–13 μ with them. Plasmodium unknown.

TYPE LOCALITY: New Caledonia.

HABITAT: Dead wood.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATIONS: K. Ned. Akad. Wet. Proc. C. 69: 344. Fig. 5, a-c.

This species is based on a specimen in the British Museum (BM 3692) determined by G. Lister as D. plumbeum var. entoxanthum (Berk.) G. Lister, which is the basis for the report of that variety as occurring in New Caledonia. The spores of D. plumbeum are not reticulate, but as that species is usually interpreted, it may approach D. dictyosporum in other respects, including color and diameter of caps.

Dictydiaethalium plumbeum (Schum.) Rost., in Lister, Mycet. 157. 1894.

FIG. 21 Plate II Fuligo plumbea Schum., Enum. Pl. Saell. 2: 193. 1803.

Reticularia plumbea (Schum.) Fries, Syst. Myc. 3: 88. 1829.

Ostracoderma spadiceum Schw., Trans. Am. Phil. Soc. II. 4: 262. 1832.

Licea rugulosa Wallr., Fl. Crypt. Germ. 2: 345. 1833.

Licea applanata Berk., Lond. Jour. Bot. 4: 67. 1845.

Lycogala lenticulare Dur. & Mont., in Durieu, Expl. Sci. Alger. Bot. 1: 401. 1848.

Reticularia entoxantha Berk., Jour. Bot. & Kew Misc. 3: 201. 1851.

Reticularia lurida Berk. & Br., Jour. Linn. Soc. 14: 82. 1873.

Licea cinnabarina Berk. & Br., Jour. Linn. Soc. 14: 86. 1873.

Licea tenuissima Berk. & Br., Jour. Linn. Soc. 14: 86. 1873.

Dictydiaethalium applanatum (Berk.) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27–28: 69. 1873.

Clathroptychium rugulosum (Wallr.) Rost., Mon. 225. 1875.

Ophiuridium dissiliens Hazsl., Oesterr. Bot. Zeits. 27: 85. 1877 (as "D." dissiliens).

Dictydiaethalium dissiliens (Hazsl.) ed., in Just, Bot. Jahresber. 5: 156. 1877. Clathroptychium cinnabarinum (Berk. & Br.) Sacc., Michelia 1: 545. 1879.

Clathroptychium dissiliens (Hazsl.) Berl., in Sacc., Syll. Fung. 7: 409. 1888. Clathroptychium berkeleyi Massee, Mon. 53. 1892.

Dictydiaethalium ferrugineum Nann.-Brem., K. Ned. Wet. Proc. C. 69: 345. 1966.

Fructification a pseudoaethalium, resembling an aethalium at maturity, composed of numerous sporangia 1–3 mm tall and (0.2–)0.3–0.5(–0.6) mm in diameter, closely compacted in a palisade layer, dull yellow to yellow-brown to dark olivaceous, or less commonly brownish red, from a few mm to 10 cm

or more in extent, borne on a thick, persistent, concolorous hypothallus, which frequently extends well beyond the margins and is then silvery or pallid; cortex composed of the thickened caps of the sporangia, united into a tessellate and usually bullate crust; dehiscence by breaking of cortex into individual caps, from which the thickened thread-like strands formed in the angular spaces between the sporangia depend from the angles of the caps, forming a pseudocapillitium, the rest of the peridium disappearing early when exposed; spores ochraceous or clay-colored, rarely bright yellow or dull red in mass, almost colorless or pale yellow by transmitted light, minutely roughened, (8.5-)9-10 (-12) μ in diameter. Plasmodium pink or rose-colored.

TYPE LOCALITY: Denmark.

HABITAT: Dead wood.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Rost., Mon. pl. 2, f. 25, 28–30; Univ. Iowa Stud. Nat. Hist. 14(8), pl. 8, f. 57–62; Lister, Mycet. ed. 3. pl. 152; Hattori, Myxom. Nasu pl. 9, f. 4, 5.

EXSICCATI: Ellis, N. Am. Fungi 335; Brândză, Myxom. Roum. 99(NY).

The many variations in size and color have resulted in numerous names applied to such variants. There seems to be complete intergradation between those forms and it is believed that they are for the most part best included within a single variable species. The only exception here made is in the case of *D. dictyosporum*, in which the reticulate spores seem to set it apart, but it may well prove that critical study will reveal other usable specific distinctions.

D. ferrugineum Nann.-Brem. is described as differing from D. plumbeum in the rusty-red color of the spore mass and the slightly larger spores with shorter spinules, and in the much smaller caps of the sporangia. However, we find all of these characters in our specimens of D. plumbeum and there seems no place where a line can be drawn.

Dictydiaethalium dissiliens Hazsl. is a very confusing name. After discussing his new genus, and citing Dictydiaethalium Rost. as its nearest relative, Hazslinszky actually wrote on p. 75 D. dissiliens, although in connection with the generic description, on the previous page, he had written Ophiuridium dissiliens. Both description and context make it clear that he was describing his new species as an Ophiuridium, and not as a new species of Dictydiaethalium. But Dictydiaethalium dissiliens was taken up in Just's Jahresbericht and thence passed into the literature. Hazslinszky's proposal for a separate family Ophiuridiaceae has never found acceptance.

D. plumbeum var. entoxanthum (Berk.) G. Lister, based on Reticularia entoxantha Berk., Jour. Bot. & Kew Misc. 3: 201. 1851, was published in connection with a report on New Caledonia Myxomycetes, and is described as olivaceous, 2–3 mm thick, and with spores bright yellow in mass. Berkeley's original specimen, now at Kew (K1660) was from Sikkim, and additional collections are recorded from Ceylon, New Caledonia and Chile. However, the New Caledonia specimen (BM 3692) was made the type and only known representative of D. dictyosporum Nann.-Brem., q.v. Whether the variety is sufficiently distinct from the species to deserve taxonomic recognition is doubtful.

Lycogala

Adans., Fam. Pl. 2: 7. 1763.

Galeperdon Wiggers, Prim. Fl. Holsat. 108. 1780.

Diphtherium Ehrenb., Sylvae Myc. Berol. 26. 1818.

Dermodium Rost., Mon. 284. 1875. Not Dermodium Link, 1815.

Antonigeppia O. Kuntze, Rev. Gen. Pl. 3(2): 443. 1898. Verrucosia Teng, Contr. Biol. Lab. Sci. Soc. China 8: 124. 1937.

Fructification an aethalium, globose, conical or pulvinate, resembling a puff-ball; cortex varying from a thick, firm, crustose shell or a rather spongy layer to a delicate membrane, nearly smooth or bearing scales or warts; pseudocapillitium of branched or simple tubes, variously sculptured to nearly smooth, sometimes penetrating the cortex. Spores often pinkish at first, changing to gray or ochraceous in mass, nearly colorless by transmitted light.

Type species, Lycoperdon epidendrum L.

The genus Lycogala was established by Micheli (1729). His illustration of L. flavofuscum (as L. griseum, majus), pl. 95 below, is particularly good. On the same plate, he also illustrated three phases of L. epidendrum and an additional species which appears to represent Leocarpus fragilis.

The spores of all species are small and those of most are delicately reticulated and the differences noted in the pseudocapillitium are not striking but seem fairly constant. The species are distinguished mainly by size, shape, and the nature of the cortex and its markings (Martin, 1967).

KEY TO SPECIES

- a. Aethalia large, mostly 2-4 cm in extent, sometimes much larger; cortex hard, thick, brittle, nearly smooth or bearing minute, slightly darkened scale-like patches; pseudocapillitium robust, often exceeding 25 μ in diameter.
 L. flavofuscum
- a. Aethalia rarely over 15 mm in diameter, often much smaller; cortex rather thin, fragile, usually bearing clearly defined scales or warts; pseudocapillitium rarely attaining 25 μ in diameter, usually much smaller.
 - Aethalia conical or subcylindrical, taller than wide, usually 2 mm or less in diameter; cortex bearing prominent dark warts arranged in a more or less reticulate pattern.
 L. conicum

b

c

- b. Aethalia subglobose, not taller than wide except when compressed in clusters; cortex not markedly reticulate.
- c. Pallid to yellow-brown, rarely blackish, mostly 3–12 mm in diameter; cortical scales neither strongly pustulate nor tessellate; pseudocapillitium strongly sculptured, 10–25 μ in diameter; spores clearly reticulate, mostly 6–7 μ in diameter. L. epidendrum
- Brownish ochraceous to dark brown or black, mostly 1–3 mm in diameter, rarely larger; cortical scales pulvinate, prominent, dark, at first pustulate, tending to become tessellate; pseudocapillitium not strongly sculptured, rarely exceeding 10 μ in diameter; spores faintly reticulate to nearly smooth, mostly under 6 μ in diameter.
 L. exiguum

Lycogala conicum Pers., Syn. Fung. 159. 1801.

FIG. 22 Plate II Lycogala nitidum Berk. & Br., Jour. Linn. Soc. 14: 81. 1873.

Lycogala atropurpureum Berk. & Br., Jour. Linn. Soc. 14: 82. 1873.

Dermodium conicum (Pers.) Rost., Mon. 385. 1874.

Antonigeppia conica (Pers.) O. Kuntze, Rev. Gen. Pl. 3(2): 443. 1898.

Aethalia conical, sessile on broad bases or occasionally approaching subcylindrical or subglobose, scattered or in small clusters of 2–3, sometimes imperfectly separated, 2–4 mm tall, 1–2 mm broad, yellowish brown, marked with dark, vesiculose scales often arranged in a reticulate pattern, especially above; dehiscence apical; pseudocapillitium of scarcely branched, slender, hyaline tubes, minutely roughened or nearly smooth, 3–8 μ in diameter; spores globose, yellow-brown in mass, colorless by transmitted light, rather coarsely reticulate, with a few scattered warts, 5–7 μ in diameter. Plasmodium rose or scarlet.

TYPE LOCALITY: Germany. HABITAT: Dead wood.

DISTRIBUTION: Widely distributed in Europe; found in North America from Pennsylvania to Florida, west to Washington and New Mexico, and south to Panama, but not common; West Pakistan; India; Japan; Hawaii.

ILLUSTRATIONS: Jour. Cinc. Soc. Nat. Hist. 15: pl. 3, f. 5; Lister, Mycet. ed. 3. pl. 157; Hattori, Myxom.. Nasu pl. 23, f. 1.

Many specimens referred to this species are no more than small and irregular fruitings of *L. epidendrum*. In its typical form, it seems distinctive.

Lycogala epidendrum (L.) Fries, Syst. Myc. 3: 80. 1829.

Lycoperdon epidendrum L., Sp. Pl. 1184. 1753.

Mucor lycogala Scop., Fl. Carn. ed. 2. 2: 496. 1772.

Mucor fragiformis Schaeff., Fung. Bavar. 4: 132. 1774.

Lycoperdon pisiforme Jacq., Misc. Austr. 1: 137. 1778.

Lycoperdon variolosum Huds., Fl. Angl. ed. 2. 645. 1778.

Galeperdon epidendrum (L.) Wiggers, Prim. Fl. Holsat. 109. 1780.

Lycoperdon chalybeum Batsch, Elench. Fung. 155. 1783.

Lycogala miniatum Pers., Neues Mag. Bot. 1: 87. 1794 (as miniata).

Reticularia rosea DC., Bull. Soc. Philom. 1: 105. 1798.

Lycogala ferruginea Schum., Enum. Pl. Saell. 2: 192. 1803.

Reticularia miniata (Pers.) Poir., in Lam. Encyc. 6: 184. 1804.

Reticularia punctata Poir., in Lam. Encyc. 6: 184. 1804.

Lycogala terrestre Fries, Symb. Gast. 10. 1817.

Lycogala affine Berk. & Br., Jour. Linn. Soc. 14: 81. 1873.

Lycogala nigricans Lloyd, Myc. Writ. 7: 1184. 1918.

Aethalia scattered or crowded, subglobose to depressed-spherical or irregular from pressure, pinkish gray or yellowish brown to deep olivaceous or nearly black, 3–15 mm broad; cortex warted with yellow to brownish black scale-like but not tessellate warts, or merely roughened, rather thin and fragile; dehiscence apical; pseudocapillitium composed of long, branching and anastomosing flattened tubes marked with conspicuous transverse folds and wrinkles, the main branches near the origin on the inner side of the cortex 12–25 μ in diameter, the secondary branches 6–12 μ in diameter, the numerous free ends clavate or obtuse; spores at first pinkish gray in mass, changing to pale ochraceous or pallid, by transmitted light colorless, globose, reticulate, 6–7.5 μ in diameter. Plasmodium coral-red.

TYPE LOCALITY: Europe. HABITAT: Dead wood.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Bull., Herb. Fr. pl. 503; Rost., Mon. pl. 1. f. 1, 7-12; Lister,
Mycet. ed. 3. pl. 156; Univ. Iowa Stud. Nat. Hist. 14(8): pl. 7, f. 50;
Hattori, Myxom. Nasu pl. 4, f. 6; Hagelst., Mycet. N. Am. pl. 16, f. 12.

FIG. 23 Plate II EXSICCATI: Ellis, N. Am. Fungi 334; Ellis & Ev., Fungi Columb. 2530; Jaap, Myxom. Exs. 17, 54; Brândză,, Myxom. Roum. 70(NY); 82(IA); Hintikka, Myxogast. Fenn. 11; Thaxter, Rel. Farl. 408.

This species looks like a small puffball, for which it is often taken, and it is not surprising that Linnaeus and several of his contemporaries called it a *Lycoperdon*. It is one of the commonest Myxomycetes, occurring on dead wood, often on rather large fallen logs, in all forested areas.

FIG. 24 Plate II Lycogala exiguum Morgan, Jour. Cinc. Soc. Nat. Hist. 15: 134. 1893.

Lycogala miniatum var. tessellatum A. Lister, in Penzig, Myxom. Buitenz. 77. 1898.

Lycogala epidendrum var. tessellatum G. Lister, in Lister, Mycet. ed. 2. 203. 1911.

Lycogala epidendrum var. exiguum (Morgan) G. Lister, in Minakata, Bot. Mag. Tokyo 27: 415. 1913.

Aethalia scattered or gregarious, subglobose, small, (0.5-)2-4(-5) mm in diameter, usually appearing dark, almost black; cortex yellow-brown, thickly covered with dark, purplish brown or black scales, these pulvinate at first with homogeneous contents, tending to become divided internally into numerous chambers and finally appearing flat and tessellate; dehiscence by an apical tear, soon becoming irregular; pseudocapillitium composed of colorless or yellow branching tubules arising from the inner portion of the cortex, often smooth at base, roughened or transversely wrinkled elsewhere, $2-10~\mu$ in diameter; spores ochraceous in mass, nearly colorless by transmitted light, marked by faint, irregular warts and lines, sometimes appearing nearly smooth, $(4-)4.5-5.5(-6)~\mu$ in diameter. Plasmodium unknown, probably pink or red.

TYPE LOCALITY: Ohio.
HABITAT: Dead wood.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Jour. Cinc. Soc. Nat. Hist. 15: pl. 3, f. 6; Hagelst., Mycet.
 N. Am. pl. 13, f. 2.

EXSICCATI: Brândză, Myxom. Roum. 83(IA).

Certainly close to *L. epidendrum*, of which it is often regarded as a variety, but the characteristic warts, the more faintly marked and smaller spores and the smoother and more slender pseudocapillitium appear to be regularly associated. Although widely distributed, it seems to be uncommon.

FIG. 25 Plate II Lycogala flavofuscum (Ehrenb.) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27-28: 68. 1873.

Diphtherium flavofuscum Ehrenb., Sylvae Myc. Berol. 27. 1818.

Reticularia flavofusca (Ehrenb.) Fries, Syst. Myc. 3: 88. 1829.

Lycogala repletum Morgan, Jour. Cinc. Soc. Nat. Hist. 18: 40. 1895.

Verrucosia corticola Teng, Contr. Biol. Lab. Sci. Soc. China 7: 124. 1932.

Lycogala corticolum (Teng) Teng, Contr. Biol. Lab. Sci. Soc. China 8: 143. 1932.

Aethalia solitary or in small clusters of 2-5, often only partially separated, sessile and pulvinate or rounded or, when developing on an inferior surface, pyriform and short-stalked, mostly 2-4 cm in their largest dimension, occa-

sionally much larger, silvery gray or ochraceous to purplish brown; cortex nearly smooth, somewhat glossy, or minutely areolate, thick, brittle; stalk, when present, membranous, lacunose, colorless, strand-like; pseudocapillitium of nearly colorless, branching and anastomosing tubes, wrinkled and papillose or nearly smooth, 25–60 μ in diameter in the main branches, 10–25 μ in the smaller branches, the axils expanded, the ends free, rounded; spores buff in mass, colorless by transmitted light, globose, faintly reticulate, 5–6 μ in diameter. Plasmodium pale pink, becoming buff, then pallid.

TYPE LOCALITY: Germany.

HABITAT: Dead wood or living trees, often at some distance above ground.

DISTRIBUTION: Throughout Europe and North America; South America;

South Africa; China.

ILLUSTRATIONS: Micheli, Nova Pl. Gen. pl. 95, f. 1 below; Lister, Mycet. ed. 3. pl. 155.

The large size, the thick, brittle, nearly smooth cortex and the very coarse pseudocapillitium are the marks of this widely distributed but rather uncommon species. Even small specimens are readily distinguished from *L. epidendrum* by the more pulvinate habit and the thick, brittle peridium. The spores are somewhat less strongly marked and slightly smaller.

EXCLUDED AND DOUBTFUL SPECIES

Lycogala cinereum Schum., Enum. Pl. Saell. 2: 193. 1803.

Cited by Lister, ed. 3. 199 as a possible synonym of L. epidendrum.

Lycogala fuliginosa Johnston, Fl. Berwick 2: 189. 1831 (as Lycogola).

Probably a small, dark form of L. epidendrum.

Lycogala globosum Schrank, Baier. Fl. 2: 638. 1789.

Not a myxomycete. Lister, ed. 3. 160.

Lycogala minutum Sacc. & Paol., Atti R. Inst. Veneta VI. 6: 5. pl. 5, f. 1. 1877.

Not L. minutum Grev., Scot. Crypt. Fl. pl. 40. 1823. Not recognizable from descr. in Sacc., Syll. Fung. 7: 436. 1888, or Massee, Mon. 125. 1892.

Lycogala niveum Hoffm., Veg. Crypt. 2: 9. 1790.

An immature Lamproderma? Lister, ed. 3. 260.

Lycogala ochraceum Massee, Mon. 125. 1892.

Not a myxomycete. Lister, ed. 3. 260.

Lycogala parietinum (Schrad.) Fries, Syst. Myc. 3: 83. 1829.

An ascomycete, Orbilia parietina (Schrad. ex Fr.) Hughes.

Lycogala platense Speg., Anal. Mus. Nac. Buenos Aires 6: 203. 1898.

Cited by Lister, ed. 3. 199, as a possible synonym of L. epidendrum.

Lycogala plumbeum Schum., Enum. Pl. Saell. 2(1408). 1803.

Cited by Berlese, in Sacc., Syll. Fung. 7: 436. 1888, as a synonym of L. epidendrum.

Lycogala rostafinskii Siemaszko, Rocznika 17: 249. 1922.

Cited by Lister, Mon. ed. 3. 198, as a possible synonym of L. flavo-fuscum.

Lycogala rufo-cinnamomeum Massee, Mon. 127. 1892.

A fungus. Lister, Mon. ed. 3. 260.

Lycogala sessile Retz. Cited by Berlese, in Sacc., Syll. Fung. 7: 435, as a synonym of L. epidendrum, with reference "Ac. Holms. 254." (Fl. Scand. Prod. 254. 1779?) n.v.

Lycogala torrendii Bres., Broteria 7: 28. 1908.

Sent by Torrend to Bresadola as a doubtful form, probably not a myxomycete. However, Bresadola decided it was a Lycogala and published it as cited. Neither the description nor the illustrations given in Torrend, Fl. Myx. 88, pl. 9, f. 19, 20. 1909, suggest a myxomycete. Saccardo & Trotter, Syll. Fung. 22: 808. 1913, cite it with a question mark.

Reticularia

Bull., Champ. Fr. 83. 1791.

Enteridium Ehrenb., Jahrb. Gewächsk. 1(2): 55. 1819.

Licaethalium Rost., Vers. 4. 1873.

Liceopsis Torrend, Bull. Soc. Port. Sci. Nat. 2: 63. 1908.

Fructification an aethalium; pseudocapillitium arising from the base and varying from perforated membranes or membranes fraying out into threads to entirely threadlike, the threads often united into a reticulation; spores brown in mass, usually more or less reticulate when free, warted on exposed surfaces when clustered.

Types species, Reticularia lycoperdon Bull.

The distinction between Reticularia and Enteridium is based on the character of the pseudocapillitium, which in the former is described as fraying out into threads, in the latter as consisting of persistent perforated membranes. In its extreme manifestations, this is striking, but there are too many intermediate expressions between the extremes to justify using it as the basis for separate genera.

Nannenga-Bremekamp (1958a) would restrict Reticularia to species with spores in which the walls are reticulate for about two-thirds of the surface. This appears to be an unnecessary limitation. If it were applied to other genera it would result in a useless multiplication of generic names.

a.	Pse	udocapillitium dendroid, at least in major part.	b
a.		udocapillitium of perforated plates, these en fraying out into threads, but not dendroid.	c
	b.	Pseudocapillitium membranous but not perforated at base, fraying out into dendroid columns of flexuous threads; cortex silvery, persistent; aethalia often large, up to 9 cm or more in extent.	R. lycoperdon
	b.	Pseudocapillitium composed entirely of	• •

dendroid columns; cortex thin, brittle, evanescent; aethalia rarely exceeding 2 cm in extent. Aethalia robust, mostly 1-3 cm in extent, sometimes

R. intermedia

smaller, often larger, up to 6 cm, and 1 cm thick; cortex firm, persistent, smooth or wrinkled, glossy brown; pseudocapillitium firm, forming a persistent network with large, rounded perforations.

R. splendens

Aethalia usually smaller and thinner: pseudocapillitium more delicate, less persistent.

d

Cortex firm, persistent, not bullate. Cortex bullate, translucent, often evanescent. e f

Aethalia pulvinate, rusty brown, small, rarely over 1.1 mm in diameter but often massed in clusters, approaching pseudoaethalia in appearance; spores free, coarsely reticulate.

R. lobata

Aethalia depressed, olivaceous, usually small but sometimes attaining 5 cm and then very thin; spores usually clustered, warted or spiny on free surfaces.

Aethalia very small, 4 mm or less, ochraceous orange; pseudocapillitium scanty; spores yellow, warted, 13 µ. R. olivacea R. aurea

Aethalia larger, up to 25 mm, red-brown or coppery; pseudocapillitium abundant; spores brown, delicately reticulate, 6-8 μ .

R. jurana

Reticularia aurea Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 69: 338. 1966.

Aethalia small, up to 4 mm in greatest extent and 0.1 mm thick, ochraeous orange, seated on a silvery hypothallus which does not extend beyond margins; peridium shiny, translucent, yellow-brown by transmitted light; dehiscence irregular; pseudocapillitium a coarse brown network of irregular, rugulose flat strands; spores golden yellow in mass, bright yellow by transmitted light, minutely and densely warted, 13 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Doorwerth, Netherlands.

HABITAT: On bark of fruit tree.

DISTRIBUTION: Known only from type collection.

ILLUSTRATION: K. Ned. Akad. Wet. Proc. C. 69: 339, f. 1.

The description suggests a *Reticularia* which differs clearly from any other known species, particularly in its very large, bright golden spores and its distinctive pseudocapillitium.

Recticularia intermedia Nann.-Brem., Med. Bot. Mus. Utrecht 149: 773. 1958.

Aethalia pulvinate, 0.5–2 cm in length, solitary, red-brown or coppery, commonly surrounded by the margin of the white hypothallus; cortex frail, evanescent; pseudocapillitium profuse, dendroid, extending throughout the aethalium, collapsing with dispersal of spores; spores free, rusty brown in mass, pale by transmitted light, delicately reticulate, with about eight meshes on the visible half of a great circle, over most of the surface, with a smooth area of dehiscence, 7–9 μ in diameter. Plasmodium white.

TYPE LOCALITY: Doorwerth, Netherlands.

HABITAT: Dead wood.

DISTRIBUTION: Netherlands; Great Britain; Greece; Bahamas.

ILLUSTRATION: Med. Bot. Mus. Utrecht 149: 774, f. 3.

This species is said to differ from R. lycoperdon in its smaller size range, the completely thread-like pseudocapillitium lacking the basal plates, the extremely fragile cortex and the more nearly complete reticulation of the spores. The author cites several collections from the type area and suggests that it may occur elsewhere. A collection from Greece (C. J. Alexopoulos GR5) and one from the Bahamas, both originally referred to Enteridium rozeanum, appear to belong here.

Reticularia jurana Meylan, Bull. Soc. Vaud. Sci. Nat. 44: 297. 1908.

Reticularia lycoperdon Bull. var. jurana G. Lister, Mycet. ed. 3: 196. 1925.

Aethalia pulvinate, 2.5–25 mm in diameter, solitary or in small clusters, red-brown or coppery, with white rim of hypothallus at margin; cortex bullate, usually very frail and evanescent except below; pseudocapillitium a uniform, firm network of membranes and threads retaining its character after spore dispersal; spores free, pale reddish brown or coppery in mass, pale brown by transmitted light, faintly reticulate, with about seven meshes to a diameter and a faintly warted or smooth area of dehiscence, 6–8 μ in diameter. Plasmodium white changing through rose to brown in fruiting.

TYPE LOCALITY: Canton Vaud, Switzerland.

HABITAT: Dead wood.

DISTRIBUTION: Switzerland, Netherlands, Great Britain, Ireland; Texas.

ILLUSTRATION: Med. Bot. Mus. Utrecht 149: 776, f. 4.

FIG. 26
Plate III

FIG. 27
Plate III

The preceding description is based on that of Nannenga-Bremekamp (1958a) who points out that R. lycoperdon and R. jurana may be found fruiting simultaneously under the same conditions, hence the differences between them cannot be regarded as due to environmental factors. She refers to the pustules which mark the surface and are indicated by the term "bullate" as representing the tops of individual sporangia, but there is no evidence in her account or in Meylan's that the fructification is a pseudoaethalium, which is what it would have to be were the constituent sporangia recognizable as such. Meylan says the spores are 5–6 μ , rarely 7 μ , i.e. averaging 2 μ less than those of R. lycoperdon. G. Lister also speaks of sporangia.

The combination of pierced membranes and threads constituting the pseudocapillitium is a further justification, if one were needed, for uniting *Enteridium* with *Reticularia*.

Reticularia lobata A. Lister, Mycet. 161. 1894.

Fig. 28

Liceopsis lobata (A. Lister) Torrend, Bull. Soc. Port. Sci. Nat 2: 63. 1908.

Aethalia small, sporangium-like, subglobose when solitary and rarely with a short stalk, 0.4–1.1 mm in diameter, usually clustered and then often angular from pressure, rusty brown or clay-colored; cortex membranous, smooth, shining, iridescent; pseudocapillitium scanty, of brown membranes and threads, sometimes lacking; spores free, globose, about two-thirds of the surface rather coarsely reticulate, with about six meshes to a diameter, the area of dehiscence with wall thinner, smooth or with a fragmentary reticulation, 7–8(–9) μ in diameter. Plasmodium watery white.

TYPE LOCALITY: England.

HABITAT: Dead wood.

DISTRIBUTION: Widely distributed in western Europe; rare in the United States and Japan; ?Ceylon.

ILLUSTRATIONS: Lister, Mycet. ed. 3, pl. 154, f. d-f; Ber. Deuts. Bot. Ges. 36: pl. 18, f. 13; Med. Bot. Mus. Utrecht No. 149: 778, f. 5, I.

An excellent account of this species is given by Nannenga-Bremekamp (1958a), who illustrates it. A collection from Oregon in the Iowa herbarium (H. C. Gilbert 944) has spores 9 μ in diameter. It is certainly this species, and the description is altered to recognize such variation. The Ceylon specimen is very questionable.

Reticularia lycoperdon Bull., Hist. Champ. Fr. 95. 1791.

FIG. 29 Plate III

Plate III

Mucor lycogalum Bolt., Hist. Fung. 3: 133. 1789. Not M. lycogala Scop. 1772.

Lycogala argentea Pers., Neues Mag. Bot. 1: 87. 1794.

Lycogala turbinata Pers., Syn. Fung. 158. 1801.

Lycogala punctata Pers., Syn. Fung. 158. 1801.

Trichoderma fuliginoides Pers., Syn. Fung. 236. 1801.

Fuligo lycoperdon Schum., Enum. Pl. Saell. 2: 193. 1803.

Reticularia argentea (Pers.) Poir., in Lam. Encyc. 6: 183. 1804.

Strongylium fuliginoides (Pers.) Ditmar, Neues Jour. Bot. Schrad. 3(3): 55. 1809.

Reticularia umbrina Fries, Syst. Myc. 3: 87. 1829.

Aethalia pulvinate, 2–8 cm broad, at first silvery white, becoming brownish; hypothallus white, forming a conspicuous margin about the base, becoming inconspicuous when powdered by the spores; pseudocapillitium arising as erect plates from the base, branching in dendroid fashion with many expansions and

ending in a mass of flattened, flexuous threads almost free from the cortex; spores rusty brown in mass, free, globose or turbinate, reticulate over about two-thirds of the surface, $8-9~\mu$ in diameter. Plasmodium creamy white.

TYPE LOCALITY: France. HABITAT: Dead wood.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Bull., Herb. Fr. pl. 446, f. 4; pl. 476, f. 1; Rost., Mon. pl. 1, f. 3, 4, 6, 13; Massee, Mon. pl. 12, f. 311, 312; Lister, Mycet. ed. 3. pl. 154, a-c; Hattori, Myxom. Nasu pl. 14, f. 3.

EXSICCATI: Brândză, Myxom. Roum. I. 1: 23, 45, 106(NY); 20(IA).

Nannenga-Bremekamp (1958a) states that in typical European specimens the spores adhere in clusters to the threads of the pseudocapillitium whereas in many, but not all, American collections, they are completely free and the reticulations are somewhat coarser. For such specimens, she proposes the variety americana, thus automatically establishing the variety lycoperdon. It is not clear that these distinctions represent more than permissible and continuous variations within a species. If so, the varietal names seem superfluous.

Reticularia olivacea (Ehrenb.) Fries, Syst. Myc. 3: 89. 1829.

Enteridium olivaceum Ehrenb., Jahrb. Gewächsk. 1(2): 57. 1819.

Enteridium atrum Preuss, Linnaea 24: 142. 1851.

Reticularia applanata Berk. & Br., Ann. Mag. Nat. Hist. III. 18: 56. 1866. Not R. applanata Schw., 1832.

Licaethalium olivaceum (Ehrenb.) Rost., Mon. 227 (as syn.). 1875.

Enteridium simulans Rost., Mon. App. 30. 1876.

Enteridium rostrupii Raunk., Bot. Tidssk. 17: 48. 1888.

Enteridium macrosporum Raunk., Bot. Tidssk. 17: 48. 1888.

Enteridium olivaceum var. liceoides A. Lister, Jour. Bot. 34: 211. 1896.

Enteridium minutum Sturgis, Mycologia 9: 329. 1917.

Enteridium liceoides (A. Lister) G. Lister, Guide Br. Mycet. ed. 4, 48. 1919.

Aethalium depressed, oval, elongate or broadly effused, 1 mm to 5 cm or more in extent, 0.6–3 mm thick, smooth or rugulose, dark olive-brown or greenish olive; hypothallus thin, membranous, transparent, often surrounding the fructification as a white margin; pseudocapillitium of thin, olivaceous, perforated plates; spores dark olivaceous in mass, pale olive or brown by transmitted light, mostly in clusters of 2–20, sometimes free, distinctly warted or spiny, the markings restricted to the free surface when clustered, smooth elsewhere, flattened or angular from pressure, 10–15 μ in diameter. Plasmodium rosy.

TYPE LOCALITY: Germany.

HABITAT: Dead wood, especially of conifers.

DISTRIBUTION: New Hampshire to New Jersey and west to Washington and California, rare in the east; Europe.

ILLUSTRATIONS: Massee, Mon. pl. 1, f. 14–18; Mycologia 9, pl. 15; Lister, Mycet. ed. 3. pl. 153, a-c; pl. 220, a-d (E. minutum).

EXSICCATI: Jaap, Myxom. Exs. 76.

A highly variable species, the fruitings ranging from clusters of small, sporangium-like aethalia to widely effused thin aethalia up to 4 cm or more in greatest extent. In many of our western collections the spores are $14-15~\mu$ in diameter or when oval, somewhat longer and narrower. In some collections they are entirely

FIG. 30 Plate III free, but in most they are united in firm clusters. All intermediates exist. Enteridium minutum Sturgis, the type of which is beautifully illustrated in the Hagelstein monograph, plate 5, is well within the general limits of the species as described above. G. Lister, Mon. ed. 3, p. 194 suggested that E. minutum was a form of the present species. We have not seen authentic material of Enteridium liceoides, but the description suggests very strongly that it belongs here.

Licea glomerulifera de By. & Rost., in Aleksandr., Miksomicetow 82. 872 (n.v.) is cited by Rostafinski, Mon. 227. 1875, as a synonym of this species, but in his index, p. 272, he says "p.p.".

FIG. 31 Plate III Reticularia splendens Morgan, Jour. Cinc. Soc. Nat. Hist. 15: 137. 1893.

Enteridium rozeanum (Rost.) Wingate, Proc. Acad. Phila. 41: 156. 1889. Probably not ?Reticularia rozeana Rost., Mon. App. 33. 1876.

Enteridium splendens (Morgan) Macbr., N. Am. Slime-moulds 151. 1899.

Aethalia pulvinate, solitary or gregarious, 0.5–6 cm broad, up to 1 cm thick, reddish brown or umber; cortex tough-cartilaginous, smooth or roughened; hypothallus white, usually forming a conspicuous ring about the base of the aethalium; pseudocapillitium a persistent uniform network of anastomosing, perforated plates arising from base and cortex and remaining attached, sometimes with frayed margins or lobes; spores brown in mass, pale brownish yellow by transmitted light, distinctly reticulate over about two-thirds of the surface, the remainder finely warted, 7–9 μ in diameter. Plasmodium watery white, changing through rose to brown.

TYPE LOCALITY: Preston, Ohio.

HABITAT: Dead wood.

DISTRIBUTION: Throughout North America; Europe; Japan; Pakistan; Liberia.

ILLUSTRATIONS: Jour. Cinc. Soc. Nat. Hist. 15, pl. 3, f. 10; Lister, Mycet. ed. 3. pl. 153, e-g; Univ. Iowa Stud. Nat. Hist. 14(8): pl. 6, f. 44; Hattori, Myxom. Nasu pl. 11, f. 1; Hagelst., Mycet. N. Am. pl. 16, f. 11. EXSICCATI: Ellis & Ev., N. Am. Fungi 3298; Brândză, Myxom. Roum. 24(IA).

Very common in North America, this species appears to be uncommon elsewhere. It differs from *R. lycoperdon* in the reddish brown peridium and the membranous, perforated plates of the pseudocapillitium, but weathered specimens of both species are similar in external appearance.

EXCLUDED AND DOUBTFUL SPECIES

Reticularia affinis Berk. & Curt., Jour. Linn. Soc. 10: 347. 1868. Not a myxomycete.

Trichosporium curtisii Massee, Jour. Myc. 5: 185. 1889 (Dematiaceae).

Reticularia angulata Pers., in J. F. Gmel., Syst. Nat. 2: 1472. 1791.

Cited by S. F. Gray, Nat. Arr. Brit. Pl. 1: 571. 1821, as synonym of *Didymium difforme* (Pers.) S. F. Gray and repeated by later authors. Identity doubtful.

Reticularia apiospora Berk. & Br., Jour. Linn. Soc. 14: 82. 1873. Not a myxomycete.

Trichosporium apiosporum (Berk. & Br.) Massee, Jour. Myc. 5: 186. 1889
(Dematiaceae).

Reticularia atrorufa Berk. & Curt., Jour. Linn. Soc. 10: 347. 1868. Not a myxomycete.

Trichosporium curtisii Massee, Jour. Myc. 5: 185. 1889 (Dematiaceae).

- Reticularia carnea (Schum.) Fries, Syst. Myc. 3: 91. 1829.
 - Based on Fuligo carnea Schum., Enum. Pl. Saell. 2: 192. 1803. Cited by Lister, ed. 3. 67, as synonym of Fuligo septica var. rufa. See Fl. Dan. 11(33): 14, pl. 1977, f. 2. Identity uncertain.
- Reticularia carnosa Bull., Champ. Fr. 85. 1791 (pl. 424, f. 1).
 - Not a myxomycete. Fries, Summa Veg. Scand. 449. 1848, suggests Ptychogaster.
- Reticularia epixylon Bull., Hist. Champ. Fr. 90. 1791, pl. 472, f. 1. 1789. Not a myxomycete. See Sacc., Syll. Fung. 7: 468, and Lister, ed. 3. 261.
- Reticularia fuliginosa Berk. & Br., Jour. Linn. Soc. 14: 82. 1873.
 - "Apparently a fungus." Lister, Mycet. ed. 3. 261.
- "Reticularia granulosa Oerst. ms.", ex Berlese, in Sacc., Syll. Fung. 7: 408.

 Cited in synonymy of Lindbladia effusa (Ehrenb.) Rost. Not validly published.
- "Reticularia lenticularis Mont. herb.", ex Rost., Mon. 225. 1875.

 Cited in synonymy of Clathroptychium rugulosum (Wallr.) Rost. Not validly published.
- "Reticularia maxima Corda", Ic. Fung. 6: 14, pl. 2, f. 35. 1854.
 - Cited by Rost., Mon. 224. 1875, as synonym of *Lindbladia effusa* (Ehrenb.) Rost., and copied in literature. Corda cited *R. maxima* Fries, hence this name is invalid.
- Reticularia multicapsula Sow., Engl. Fungi, pl. 179. 1798. The description is vague and the figure indeterminate, but it could represent *Tubifera ferruginosa*, as cited by Berlese, in Sacc., Syll. Fung. 7: 407. 1888. See Fries, Summa Veg. Scand. 449. 1848.
- Reticularia nigra Bull., Champ. Fr. 88. 1791, pl. 380, f. 2 (1787). Not a myxomycete.
- Reticularia nitens Morgan, Jour. Cinc. Soc. Nat. Hist. 18: 40. 1895.
 - G. Lister, Mycet. ed. 2. suggests that this may be either Stemonitis confluens (p. 136), which seems doubtful, or Amaurochaete cribrosa (p. 165), which is perhaps less doubtful. Morgan's specimen is not in the IA collection. "R. nitens Fries", in Lister, ed. 3. 288 (index) is a typographical error.
- Reticularia polyporiformis Berk., Jour. Linn. Soc. 14: 352. 1874. Lister, ed. 3. 261, "a fungus."
- Reticularia pyrrhospora Berk., Jour. Linn. Soc. 10: 347. 1868. Not a myxomycete.

 Trichosporium pyrrhosporium (Berk.) Massee, Jour. Myc. 5: 185. 1889.

 (Dematiaceae).
- Reticularia ramosa J. F. Gmel., Syst. Nat. 2: 1471. 1791. Not a myxomycete. Lister, ed. 3. 261.
- Reticularia rosea Poir., in Lam. Encycl. 8, no. 21. 1808. n.v.
 - Cited by Berlese, in Sacc. Syll. Fung. 7: 436, as a synonym of Lycogala epidendrum. Possibly based on Reticularia rosea Bull., "Philom. n. 14. florial an 6", as cited in de Candolle, Fl. Fr. 2: 259. 1805. The description suggests a Lycogala.
- Reticularia segetum Bull., Hist. Champ. Fr. 90. 1791, pl. 472, f. 2. (1789). Not a myxomycete. A smut.
- Reticularia stipitata Bull., Hist. Champ. Fr. 89. 1791, pl. 380, f. 3. (1787). Cited by Berlese, in Sacc., Syll. Fung. as the basionym of Diderma stipitatum (Bull.) Fries, Syst. Myc. 3: 104. 1829, not listed in recent works. Bulliard's figure certainly suggests a myxomycete, possibly a Badhamia.
- Reticularia testacea Wallr., Fl. Crypt. Germ. 2: 340. 1833. Cited by Berlese, in Sacc., Syll. Fung. 7: 436, as synonym of Lycogala flavofuscum. Lister, ed. 3. 198, "doubtful".
- Reticularia ungulina (Schum.) Fries, Syst. Myc. 3: 89. 1829. Cited by Berlese, in Sacc., Syll. Fung. 7: 410. 1888, as a synonym of Enteridium olivaceum. Doubtful. See Fl. Dan. 11(33): 14. 1829, pl. 1977, f. 2.
- Reticularia venulosa Berk. & Curt., Jour. Linn. Soc. 10: 347. 1868. Not a myxomycete. Trichosporium curtisii Massee, Jour. Myc. 5: 185. 1889. "R. venosa" Sacc., Syll. Fung. 7: 419, is an error.
- Reticularia versicolor Fries, Syst. Orb. Veg. 147. 1825. Fuller description in Syst.

Myc. 3: 90. 1829, with no reference to earlier publication. *Lindbladia versicolor* (Fries) Rost., in Fuckel, Jahrb. Nass.-Ver. Nat. 27–28: 68. 1873, is based on this and *Licea glomerulifera* de By. & Rost., and *L. olivacea* Fuckel, Jahrb. Nass.-Ver. Nat. 23–24. 1873 (not *L. olivacea* Ehrenb. 1819) are cited as synonyms. Both have been referred to *Reticularia olivacea*, and this may be correct.

Cribrariaceae

Rost. Versuch 5. 1873 (as Tribus)

Sporangiate, usually stalked, or, in *Lindbladia*, mostly sessile and then often merged into pseudoaethalia or aethalia. Capillitium lacking. All parts of fructification including spores, bearing minute, typically dark granules (dictydine granules). Peridium in *Lindbladia* continuous or nearly so, if netted, interstices rarely fugacious; in the other genera netted over the entire surface or over the upper part, the interstices fugacious, so that at maturity the peridium is represented either by a complete net or a net above and a calyculus below. Spores yellow, brown, red or purple in mass, pale or bright-colored by transmitted light.

The dictydine granules, usually conspicuous except in *Lindbladia*, the lack of a capillitium and the persistent surface net in *Cribraria* and *Dictydium* make most members of this family easy to recognize as such.

KEY TO GENERA

a. Sporangia usually closely aggregated on an extensive, often thick and spongy hypothallus, the walls often united or fused, forming a pseudoaethalium or an aethalium, rarely scattered; net lacking or scantily developed, and peridium rarely if ever dehiscent between meshes; dictydine granules few and concolorous with membranes.

Lindbladia

 Sporangia usually free, aggregated or scattered; net always present, usually well-developed; hypothallus delicate; dictydine granules numerous, darker than spores.

h

- b. Threads of net short, meeting at thickened or expanded nodes. Cribraria
- b. Main threads of net stout, longitudinal, subparallel at least below, connected by very delicate transverse threads; peridium sometimes netted above.

Dictydium

Lindbladia

Fries, Summa Veg. Scand. 449. 1849.

Fructification typically aethalioid, but varying from clustered, sessile or rarely substipitate sporangia through densely massed and united sporangia which form a pseudoaethalium or a true aethalium. Peridium relatively thick, without a surface net or with a delicate surface net on some or all of the constituent sporangia, but peridium not fugacious between meshes. Dictydine granules present but concolorous with membranes and usually inconspicuous. Hypothallus extensive, firm, often thick and more or less spongy. Spores dark olivaceous brown in mass.

Type species, Lindbladia tubulina Fries.

Distinctly intermediate between the Reticulariaceae and Cribrariaceae, but grouped with the latter on the basis of the dictydine granules and the occasional presence of a net on the surface of the upper part of the peridium. The more sporangiate fruitings approach those of *Cribraria argillacea* rather closely; in the specimens which are regarded as pseudoaethalia, the sporangia, although united, retain their identity. In some fruitings, however, there is no evidence that sporangia were differentiated before the spores were formed; such fruitings are regarded as true aethalia.

A single species.

Lindbladia tubulina Fries, Summa Veg. Scand. 449. 1849.

FIG. 32 *Plate* III Aethalium atrum Preuss, Linnaea 24: 141. 1851.

Lindbladia effusa (Ehrenb.) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27-28: 68. 1873.

Licea spermoides Berk. & Curt., in Berk., Grevillea 2: 68. 1873.

Physarum caespitosum Peck, Ann. Rep. N. Y. State Mus. 26: 75. 1874.

Perichaena caespitosa (Peck) Peck, Ann. Rep. N. Y. State Mus. 31: 57. 1879.

Tubulina spermoides (Berk. & Curt.) Massee, Mon. 37. 1892.

Tubulina effusa (Ehrenb.) Massee, Mon. 41. 1892.

Tubulina caespitosa (Peck) Massee, Mon. 43. 1892.

Enteridium yabeanum Emoto, Bot. Mag. Tokyo 46: 170. 1932.

Fructification sporangiate to pseudoaethalioid or aethalioid, on a tough, dark, often spongy, broadly effused and continuous hypothallus; aethalia flattened pulvinate, dark olivaceous brown to nearly black, covered with a thick cortex which may be merely roughened or may be tessellate; sporangiate forms varying from pseudoaethalia to densely clustered or, less commonly, gregarious sporangia, 0.3–0.7 mm in diameter, bright olivaceous brown to blackish, often more or less iridescent; entire fructification 2–20 cm or more in extent, the membranes thickly dotted with indistinct, often clustered, dictydine granules, in the more aethalioid forms remaining after dehiscence as a pseudocapillitium; net lacking or on surface of upper peridium, but not becoming perforate; spores olivaceous brown in mass, pallid by transmitted light, globose, faintly warted, 6–7.5 μ in diameter. Plasmodium nearly black.

TYPE LOCALITY: Germany.

HABITAT: Coniferous wood and sawdust; less commonly on angiosperm wood or litter.

DISTRIBUTION: Europe; temperate North America, especially in conifer forest areas, south to Louisiana; Ceylon; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 137; Univ. Iowa Stud. Nat. Hist. 14(8): pl. 6, f. 42; pl. 7, f. 56; Bot. Mag. Tokyo 46, pl. 1, f. 1–3.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2700; Ellis & Ev., Fungi Columb. 1397; Brândză, Myxom. Roum. 43, 44(NY); 75, 76(IA); Thaxter, Rel. Farl. 407.

An extremely variable species. The aethalioid fruitings suggest Reticularia. However, the sporangiate nature of the spore-filled compartments is usually evident, and the dictydine granules, while not as prominent as in most Cribrarias, are usually apparent. Lister gives the spore size as 4–6 μ and this is repeated by Hagelstein. An English collection, probably from G. Lister, has spores 6–7 μ in diameter, as do two British collections by Plowright. The spores of most American collections are essentially the same size or slightly larger. The substrate is usually coniferous wood or sawdust, but the very tough hypothallus makes it easy to collect material with little of the substratum attached; some collections are certainly on angiosperm wood or litter.

This species has long been known as Lindbladia effusa (Ehrenb.) Rost., based on Licea effusa Ehrenb., Sylvae Myc. Berol. 26. 1818, as published first by Fuckel and later in Rost., Mon. 224. 1875. However, in the index of the monograph, p. 372, L. effusa is cited as "p.p. Lindbladia effusa". Reference to Ehrenberg's original description and his figures, especially 1, A-C, make it clear that they cannot apply to Lindbladia and strongly suggest that they are Tubifera ferruginosa. The same applies to Aethalium melaenum Chev., Fung. Byss. Illustr. 1: pl. 32. 1837. Chevallier's (unpaged) description and the figure make it more than doubtful whether they can apply to Lindbladia. There can be little question as to the appli-

cation of Fries's name and it seems desirable to revert to it for the type and only species of what Fries called this "nobilissimum genus".

The inclusion of *Enteridium yabeanum* in the synonymy is based on study of a collection from Washington made by Dr. E. E. Tylutki which agrees in every respect with Emoto's description of that species, and is slightly larger, 20×17 cm, than Emoto's specimen. This collection merges through others into typical examples of the species.

The var. cribrarioides Emoto, Jap. Jour. Bot. 12: 353. 1936, was erected for forms with a net on the upper surface but, as noted in the description, that character is variable, even in the same collection.

Cribraria

Pers., Neues Mag. Bot. 1: 91. 1794.

Hypothallus thin, delicate. Fructifications sporangiate, globose or pyriform, usually stalked. Sporangial wall thickened above and often below in net-like fashion, fugacious at maturity between the meshes of the net, leaving only the netted portion and frequently a cup-like base, the calyculus, from which the net arises. Veins of net short, meeting at nodes which are usually expanded and sometimes notably thickened. Dictydine granules present on cup and net and usually on spores.

Type species, Cribraria rufescens Pers.

Cribraria is for the most part a well-marked genus. Sporangiate phases of Lindbladia tubulina do resemble certain phases of C. argillacea, but in the former the net, if present, is superimposed on the persistent peridium, whereas in the latter the peridium is much thinner and falls away from the interstices of the net. Some fruitings of Dictydium mirabile are quite Cribraria-like, as are occasional fruitings of Dictydium cancellatum, particularly those which have developed under alpine conditions. For these reasons, Nannenga-Bremekamp (1962a) has proposed to unite the two genera. Martin (1962a) studied the same problem independently and decided they were better kept separate. There is no serious disagreement about the facts involved; it is merely a question as to how they are best interpreted. For the present, we are maintaining the separation.

The species often present great difficulty. All of the characters used to distinguish them tend to be inconstant and to vary with the maturity of the collection and with the conditions under which it may have matured. This is well illustrated by the presence or absence of a calyculus. Probably all species have a peridium which tends to persist at the base longer than above. In the majority of species this is fixed. In others, of which C. microcarpa and C. intricata are the commonest examples, the basal portion, in well-matured specimens, tends to disappear at maturity, but in specimens which have been checked by drying before full maturity a calveulus may be present, although often rudimentary or incomplete. Some collections may show a range in this character, with sporangia in exposed areas having a calyculus while those in more sheltered portions lack it. The distinction between flat and thickened nodes is useful and fairly constant, but intermediate phases do occur. This character is best seen in mounts in which the nodes may be observed in profile at the margins of the sporangia. Color of sporangium and of spore-mass is distinctive in some species, but not in all. Size of spores is useful for a few species and the same is true for color and size of plasmodic granules. The following key attempts to stress the usual characteristics of the species recognized but it will always be necessary to consider possible variance from the key characters.

Cribraria Schrad. ex J. F. Gmel., Syst. Nat. 2: 1471. 1791, with the single species C. pallida Schrad. ex Gmel., antedates Persoon's publication by three years, but the generic description is vague and the species, otherwise unknown, is merely named with the citation "Schrader fung. ined."

a.	Nod	les distinctly pulvinate to hemispherical when viewed laterally.			
a.	Nod	les flat or only slightly thickened then usually expanded, scarcely pulvinate.	1		
	b.	Lilac, rose-red or purple.	c		
	b.	Ochraceous to yellow or brown, sometimes with reddish or purplish tints, but never bright red or purple.	d		
c.	Dee	ep, clear, dark purple.	C. lepida		
c.	Dee	ep maroon or rose-purple. (Nodes somewhat thickened, expanded nor pulvinate, but might be looked for here.)	C. elegans		
	d.	Sporangia reddish ochraceous to hazel or coppery; stalk long, slender, usually more than 6/7 total height.	e		
	d.	Sporangia yellow, ochraceous or clay-colored to olivaceo or dusky; stalk shorter, thicker, never 6/7 total height.	us g		
e.	dia	zel or coppery, usually over 0.3 mm in meter; cup well-developed; stalk rarely eeding 10 times diameter of sporangium.	C. languescens		
e.	Rec	ldish ochraceous to hazel but not coppery; cup			
		imentary or lacking; stalk 10-20 times diameter of sporan	gium. f		
	f.	Nodes hemispherical, dark, strongly concave			
		on inner side; threads of net slender, not rigid nor flattened; dictydine granules dark.	C. microcarpa		
	f.		C. microcarpa		
	1.	Nodes pulvinate, pallid, slightly concave on inner side; threads of net coarse, rigid, somewhat flattened; dictydine granules pale.	C. pachydictyon		
g.	Da	rk brown; stalk 1-2 times height of			
•		rangium; net notably large-meshed; crowded, on leaves.	C. laxa		
g.	Ocl	nraceous to dusky; stalk usually longer;			
	me	shes of net not notably large; on wood.	h		
	h.	Cup tending to be obconical; stalk expanded at apex.	C. piriformis		
	h.	Sporangia globose; stalk cylindrical or subulate, not expanded at apex.	i		
i.	Brig	ght yellow to ochraceous or clay-colored.	j		
i.		Dingy olivaceous to dusky.			
	j.	Bright yellow to ochraceous; nodes pulvinate throughout; cup ample, well-defined.	C. aurantiaca		
	j.	Dull ochraceous to clay-colored; nodes			
	•	pulvinate only above; cup more or less replaced by flattened ribs, these merging gradually into net.	C. martinii		
k.		orangia 0.5–0.7 mm in diameter; nodes pulvinate expanded and angular; net with numerous free ends.	C. intricata		
k.		orangia 0.3–0.5 mm in diameter; nodes npact, rounded; net with few free ends.	C. tenella		
	1.	Bright red; crimson or purple.	m		
	1.	Yellow, ochraceous, or olivaceous, to dull reddish brow	n. q		
m.		ep, clear purple, rarely over 0.3 mm diameter; nodes large, expanded, irregular.	C. violaced		
m.	Lil	ac or reddish purple to crimson brick-red; rarely under 0.3 mm. in diameter.	r		
	n.	Deep maroon to reddish purple, mostly			
	11,	0.3-0.5 mm in diameter; nodes small, prominent, somewhat thickened but not pulvinate, scarcely expand	ed. <i>C. elegan</i> s		
	n.	Reddish purple to crimson or brick-red; larger; nodes	tular (

KEY TO SPECIES

o.	Reddish purple, darkening with age, mostly 0.6-1 mm in diameter; nodes irregular, widely expanded; cup well-developed, obscurely ribbed, sometimes plicate. C. purpu	
o.	Crimson to brick-red, sometimes darkening with age, rarely under 1 mm in diameter; cup never plicate; nodes scarcely expanded.	р
	p. Dull crimson, 1-2 mm in diameter; net small-meshed, merging into the deep, smooth cup.	C. rubiginosa
	p. Brick-red to reddish purple, tending to darken, 1-1.5 mm in diameter; net with large, open meshes, distinct from prominently ribbed cup.	C. ferruginea
q. .	Clay-colored to olivaceous, densely crowded and then sessile or short-stipitate, or gregarious and then with longer stems; net weak, easily detached; cup deep in gregarious fruitings, not clearly defined when crowded	l. C. argillacea
q.	Net well-developed, persistent; sporangia rarely if ever sessile.	r
	r. Cup usually replaced by 8–15 firm ribs radiating from tip of stalk, these free or sometimes partially connected by delicate, fugacious membrane	s. C. splendens
	r. Cup present or absent, when present, often ribbed, but ribs connected by persistent membrane	s. s
s.	Sporangia minute, rarely over 0.2 mm in diameter, often smaller; cup often lacking.	t
s.	Sporangia larger, rarely under 0.2 mm in diameter, often much larger; cup always present.	u
	t. Bright yellow-brown to coppery; stalk 1-4 times height of sporangium; cup present or absent.	C. minutissima
	t. Hazel brown, not coppery; stalk 8-13 times height of sporangium; cup lacking.	C. pachydictyon
u.	Cup deep, strongly ribbed, perforated above, merging gradually into the coarsely meshed, irregular net; brown or bronze.	C. macrocarpa
u.	Cup not perforated, sharply distinguished from net.	v
	v. Dull orange-brown to ferruginous, sometimes darker with age.	w
	v. Hazel or bronze to purplish brown or blackish.	х
w.	Sporangia mostly 0.2–0.4 mm in diameter; spores orange-brown in mass; nodes sometimes thickened, but not pulvinate.	C. oregana
w.	Sporangia mostly 0.6–0.7 mm in diameter; spores nut-brown in mass; net notably lax, with flat, scarcely expanded nodes.	C. rufa
	x. Dark purplish brown to nearly black, shining; cup bearing concentric lines of granules inside and out; spores verrucose, sometimes bearing a delicate, broken reticulation on surface.	C. atrofusca
	x. Hazel to purplish brown, not shining; cup not bearing concentric lines of granules.	y
y.	Spores 7–8 μ in diameter, angular in outline, bearing reticulate lines of warts.	C. dictyospora
y.	Spores rarely exceeding $\theta\mu$ in	J. wiergosporu
•	diameter, reticulate lines faint or lacking.	C. vulgaris

FIG. 33 Plate III Cribraria argillacea (Pers.) Pers., Neues Mag. Bot. 1: 91. 1794.

Stemonitis argillacea Pers., in J. F. Gmel., Syst. Nat. 2: 1469. 1791.

Cribraria micropus Schrad., Nov. Gen. Pl. 3. 1797.

Trichia argillacea (Pers.) Poir., in Lam. Encyc. 8: 55. 1808.

Sporangia dull ochraceous to olivaceous, globose to obovate, 0.5–1 mm in diameter, sessile or short-stipitate, densely crowded, closely gregarious or massed to form a pseudoaethalium; peridium fugacious above except for a weak, easily detached net without nodal thickenings; lower portion remaining as a deep, often poorly defined cup, usually membranous above, thicker below and marked with ribs or reticulations or, when free, becoming entirely reticulate; dictydine granules small, 0.5–1.5 μ in diameter, irregular, brown, often obscure; stalk, when present, usually short, rarely as much as 1 mm long, furrowed, dark brown to black, arising from a well-developed hypothallus; spores clay-colored in mass, pallid by transmitted light, nearly smooth, 6–8 μ in diameter. Plasmodium lead-colored.

TYPE LOCALITY: Europe. HABITAT: Dead wood.

DISTRIBUTION: Widely distributed in Europe and North America; South

ILLUSTRATIONS: Schrad., Nov. Gen. Pl. pl. 2, f. 1, 2; Lister, Mycet. ed. 3. pl. 138; Acta Bot. Neerl. 13: 134, f. 1, 2.

EXSICCATI: Brândză, Myxom. Roum. IIb: 24(NY); Ellis & Ev., N. Am. Fungi 2899; Jaap, Myxom. Exs. 51, 136, 157, 198.

Some forms of this variable species are quite similar to sporangiate fruitings of Lindbladia tubulina, but may be distinguished by the thinner peridium, with a definite net above. Nannenga-Bremekamp (1964b) compares it with C. oregana and C. martinii. She says the threads of C. argillacea are never glossy as in C. oregana, but in specimens which we refer to C. argillacea, the threads, and in fact the entire net, may be bronze and glossy. Hagelstein (1944) mentioned connecting forms between C. argillacea and Lindbladia.

Cribraria atrofusca Martin & Lovejoy, Jour. Wash. Acad. 22: 92. 1932.

FIG. 34 Plate III Sporangia loosely gregarious, globose or somewhat obovate or pyriform, usually erect, dark purplish brown to nearly black, iridescent, shining, 0.3–0.6 mm in diameter, 1–2.2 mm tall; cup occupying about one-half of the sporangium, supported by slender, granular ribs radiating from the stipe and with broken, concentric, granular corrugations deposited on the inside and outside, the margin bearing fine teeth, and long, slender toothlike projections, these bearing the net and similar to its internodes; dictydine granules dark, rather large, up to 2.5 μ in diameter; net regular, the nodes expanded, scarcely thickened, granular, dark brown, the connecting threads broad, their free ends few, arising both from nodes and connecting threads, the silvery peridium tending to persist, hypothallus small; stalk slender, furrowed, dark brown to nearly black, narrowed below the base of the sporangium, 0.6–1.8 mm long; spores dark reddish brown in mass, grayish brown by transmitted light, somewhat angular, finely verrucose with faint, broken reticulate pattern, 7–8 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Colorado. HABITAT: Dead wood.

DISTRIBUTION: Colorado, Oregon; Philippines. ILLUSTRATIONS: Jour. Wash. Acad. 22: 90. f. 10–13; Macbr. & Mart. Myxom. pl. 15, f. 368–370.

Hagelstein (1944) regarded this as a synonym of *C. piriformis*. The sporangia of some specimens suggest that species, but the much darker color, the concentric arrangement of granules on the cup which are admittedly not always clear, the slightly larger spores and the long, dark stalk not merging gradually into the base of the sporanium seem constant in specimens from the western United States.

The specimen from the Philippines was collected at an altitude of 7200'.

Cribraria aurantiaca Schrad., Nov. Gen. Pl. 5. 1797.

Cribraria vulgaris var. aurantiaca (Schrad.) Pers., Syn. Fung. 194. 1801.

Sporangia gregarious, globose, stipitate, erect or nodding, at first bright yellow, soon changing to ochraceous brown, 0.3–0.6 mm in diameter, total height 1–2 mm; stalk subulate, dark, 2–4 times the height of the sporangium, cup usually well-developed, occupying one-fourth to one-third the lower portion of the sporangium, occasionally less, the margin even, bearing numerous elongate teeth with few spines or angles which bear the net; net regular, with small meshes and few free ends; nodes numerous, small, rounded, convex, dark; dictydine granules moderately dark, 1–1.5 μ in diameter; spores nearly smooth, (5–)6–7 μ in diameter. Plasmodium greenish.

TYPE LOCALITY: Germany.

HABITAT: Dead wood.

DISTRIBUTION: Europe; southern and eastern Asia; southern Canada; United States.

ILLUSTRATIONS: Schrad., Nov. Gen. Pl., pl. 1, f. 3, 4; Lister, Mycet. ed. 3, pl. 142, f. c, e; Acta Bot. Neerl. 13: 136, f. 3.

This species, since the time of Persoon, has been regarded as a variety of C. vulgaris or combined with it. Nannenga-Bremekamp (1964b) has pointed out a number of ways in which the two forms differ and some of these seem to be of sufficient importance to justify her contention that two species are recognizable. Her treatment is adopted.

The varieties sulphurea Wallr., Fl. Crypt. Germ. 2: 362. 1833, and flava Alb. & Schw., Consp. Fung. 106. 1805, may refer to minor color variations of either this or a related species. C. variabilis Ficin. & Schub., Fl. Dresden ed. 2. 2: 269. 1823, is cited as a synonym by Berlese.

Because of the confusion with C. vulgaris, the distribution data are necessarily unreliable.

Cribraria dictyospora Martin & Lovejoy, Jour. Wash. Acad. 22: 92. 1932.

Sporangia gregarious, stipitate, globose, erect or slightly nodding, hazel to dark purplish brown, 0.4–0.8 mm in diameter, 1–2 mm tall; cup regular, occupying about one-third of the sporangial area, marked with irregular, dark, granular rays, the margin toothed; net rather fine-meshed, the nodes flat and angular, not greatly thickened, densely filled with large, dark granules about 2–3 μ in diameter which makes them appear black, the connecting threads narrow, with abundant, often branched, free ends, arising both from the nodes and from the connecting threads; stalk slender, two or three times the diameter of the sporangium, furrowed, sometimes pale at the apex, otherwise dark; spores

FIG. 53 Plate V

FIG. 35 Plate III orange-brown in mass, pale lilac by transmitted light, globose or somewhat angular, warted and covered with a coarse and often imperfect reticulum of 3–5 meshes to the hemisphere, 8–9 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Oregon. HABITAT: Dead wood.

DISTRIBUTION: Known only from Oregon.

ILLUSTRATIONS: Jour. Wash. Acad. 22: 90. f. 8, 9; Macbr. & Mart., Myxom. pl. 14, f. 365, 366; Acta Bot. Neerl. 13: 147, f. 13.

Hagelstein (1944) recognized the species, but said it was "practically C. piriformis, except for the spores" and denied that the spores are reticulate. The spores are large for Cribraria and the reticulations are present and usually prominent but sometimes visible only by careful focusing. They may be due to ridges left by contraction, which Hagelstein suggested was the case in Badhamia gracilis, the spores of which bear similar reticulations. If that is the case, such contraction is characteristic of both species, while rare in others. In C. piriformis, the nodes are definitely thickened and pulvinate. C. dictyospora has more in common with C. ferruginea Meylan, as noted under that species. Nannenga-Bremekamp (1964) thinks it closer to C. vulgaris and probably to be included in that species.

Cribraria elegans Berk. & Curt., in Berk., Grevillea 2: 67. 1873.

FIG. 36 *Plate* III Sporangia gregarious, globose, stipitate, erect or nodding, 0.3–0.5 mm in diameter, brick-red to deep maroon or rose-purple; stalk variable in length, usually long, slender, tapering upward, dark, from 1–6 times the diameter of the sporangium, arising from a scanty hypothallus; calyculus one-third to one-half the sporangium, finely ribbed, covered, especially above, with purple dictydine granules 2–2.5 μ in diameter, the margin toothed or perforate; net well-developed, the nodes dark, small, rather flat, but distinctly thickened, the meshes small, polygonal, the threads delicate, colorless, with many free ends; spores purple in mass, pale violaceous by transmitted light, smooth, 6–6.5 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: South Carolina.

HABITAT: Dead wood.

DISTRIBUTION: Widely distributed in the United States, but not common. ILLUSTRATIONS: Lister, Mycet. ed. 3., pl. 146, d-f; Macbr. & Mart., Myxom., pl. 14, f. 361, 362.

Somewhat similar in color to *C. purpurea* but more rosaceous, and smaller, with regular thickened nodes, dark dictydine granules and altogether a more trim appearance. The color is also similar to that of *Dictydium cancellatum* and, as in that species, is readily washed out and colors the substratum. The net, of course, is wholly different. The nodes are definitely thickened but not strikingly pulvinate.

Cribraria ferruginea Meylan, Ann. Cons. Jard. Genève 15-16: 319. 1913.

FIG. 37 *Plate* IV Sporangia crowded or gregarious, subglobose, brick-red to deep purplish red, 1–1.5 mm in diameter; stalk dark brown, furrowed, short, 0.5–1 mm tall; total height 2 mm or more; cup about one-third the height of the sporangium, irregularly toothed at the margin, with prominent ribs united by a thin, metallic membrane; net loose, irregular, the nodes angular, irregular, flat or scarcely differentiated, filled with dictydine granules about 2 μ in diameter, the threads

slender; spores brick-red in mass, pallid by transmitted light, angular, minutely warted, 7–8 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Switzerland.

HABITAT: Dead coniferous wood.

DISTRIBUTION: Switzerland. Reported from Tennessee, Oregon, New Mexico.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 219, a-d.

Our collection from Meylan is rather old and quite dark. A specimen from Tennessee is provisionally referred here and the reports from Oregon and New Mexico are based on Hagelstein (1944).

The spores of the Meylan collection are somewhat angular and there is a suggestion of the overlying reticulum as in *C. dictyospora*. It is possible the two species should be united, in which case Meylan's name has priority. However, the color difference is so striking that that should not be done without further study.

Cribraria intricata Schrad., Nov. Gen. Pl. 7. 1797.

Trichia intricata (Schrad.) Poir., in Lam. Encyc. 8: 56. 1808.

Cribraria dictydioides Cooke & Balf., in Massee, Mon. 65. 1892.

Cribraria intricata var. dictydioides (Cooke & Balf.) A. Lister, Mycet. 144. 1894.

Sporangia gregarious, globose, stipitate, nodding, commonly dusky brown, but varying from pale ochraceous to nearly black, 0.5–0.7 mm in diameter; stalk 1.5–3 mm long, slender, furrowed, tapering upward, dark brown; cup present or absent, when present, delicate, strongly ribbed, varying from bowl-like and occupying the lower third of the sporangium, through shallow and saucer-like to a basal disk; net regular, the nodes dark, prominent, thickened, expanded, angular, each giving rise to 5–8 connecting threads and one or more, usually several, free ends, the meshes of medium size, often triangular; hypothallus conspicuous; dictydine granules brown, rather small; spores ochraceous in mass, pallid by transmitted light, spinulose, 5–6 μ in diameter. Plasmodium greenish, lead-colored, or brownish black.

TYPE LOCALITY: Germany.

HABITAT: Dead wood.

DISTRIBUTION: Cosmopolitan. Abundant in North America and the tropics, apparently less common elsewhere.

ILLUSTRATIONS: Schrad., Nov. Gen. Pl. pl. 3, f. 1; Lister, Mycet, ed. 3. pl. 143, a-e; Hattori, Myxom. Nasu pl. 15, f. 3; Acta Bot. Neerl. 13: 139, f. 6. EXSICCATI: Ellis & Ev., N. Am. Fungi 2095; Brândză, Myxom. Roum. 49(NY).

This species is close to *C. tenella*, which is, however, smaller, neater, with fewer connecting threads, few or no free ends, and less-branched nodes, and, in American collections at least, relatively longer stems. It is the commonest large *Cribraria* in temperate North America, often occurring in extensive fruitings on both coniferous and angiosperm wood. In most collections the cup is either present or absent in all sporangia, but not rarely both conditions may be found in the same fruiting. The var. *dictydioides* grades imperceptibly into the species as described in all the characters supposed to distinguish it.

FIG. 38 Plate IV Cribraria languescens Rex, Proc. Acad. Phila. 43: 394. 1891.

FIG. 39 Plate IV Cribraria cuprea Morgan, Jour. Cinc. Soc. Nat. Hist. 15: 142. 1893.

Sporangia gregarious or scattered, stipitate, small, 0.25–0.4 mm in diameter, nut-brown or copper-colored, often with lilaceous or purplish tints or shades, to dark purplish brown; stalk concolorous above, darker below, usually long, slender and tenuous, up to 10 times the diameter of the sporangium, sometimes relatively short; cup usually well-developed, occupying the lower third or half of the sporangium, finely ribbed and dotted with dark granules, the margin nearly even; net varying from open to rather close, the threads slender, with few free ends; nodes large, thickened, rather flat and angular; dictydine granules pallid to purplish brown, 0.3–1.5 μ in diameter; spores dull reddish or copper-colored in mass, pale by transmitted light, globose, nearly smooth, 6–7.5 μ in diameter. Plasmodium reported as red; Mrs. Allen has seen it fruiting many times, always from a dingy purplish black plasmodium.

TYPE LOCALITY: New York. HABITAT: Dead wood.

DISTRIBUTION: Widely distributed in North America; Europe; Asia; Africa. ILLUSTRATIONS: Jour. Cinc. Soc. Nat. Hist. 15: pl. 3, f. 11; Lister, Mycet. ed. 3. pl. 154, f. a-c; Macbr. & Mart., Myxom. pl. 14, f. 346, 347.

Lister's illustration is much too purple, although some specimens assigned to *C. cuprea* approach it, but is otherwise excellent. In size and general appearance, this species overlaps *C. microcarpa*. Both species are rather small, slender, long-stalked. They can be distinguished by the larger, flatter nodes and the brown or coppery color of *C. languescens* as compared with the smaller, more rounded nodes and ochraceous color of *C. microcarpa*, which is also smaller and with a relatively longer stalk. *C. languescens* always has a calyculus, which is lacking in *C. microcarpa* or represented by a disk at the base of the sporangium. The differences in reported size of the dictydine granules are perhaps of less significance.

FIG. 40 Plate IV Cribraria laxa Hagelst., Mycologia 21: 298. 1929.

Sporangia closely gregarious, stipitate, erect, globose, 0.4–0.6 mm in diameter, deep ochraceous brown; stalk dark brown, furrowed, short, 0.7–1.4 mm in height, total height 1–1.6 mm; cup occupying about one-third of the sporangium, strongly ribbed with numerous cross veins connecting the ribs, between them a thin glistening partly fugacious membrane; net arising from the ribs, widemeshed, the nodes large, thickened, pulvinate, dark brown, crowded with minute dictydine granules, about 0.5 μ in diameter, the connecting threads slender and lax with few free ends; hypothallus very broad; spores clay-colored in mass, pale by transmitted light, warted, 6–7 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Long Island, New York. HABITAT: Dead leaves or small twigs.

DISTRIBUTION: New York, Pennsylvania, Virginia.

ILLUSTRATIONS: Mycologia 21, pl. 26, f. 4-6; Hagelstein, Mycet. pl. 12, f. 4.

The distinctive characters of this species are the moderately large, shortstemmed, wide-meshed sporangia occurring mostly on leaves in wet areas. All other species of the genus occur habitually on wood. Cribraria lepida Meylan, Bull. Soc. Vaud. Sci. Nat. 56: 326. 1927.

Sporangia stalked, nodding, gregarious, deep purple, 0.25–0.5 mm in diameter; stalk 2–5 mm long, 6–10 times the diameter of the sporangium, calyculus occupying one-third, less commonly nearly one-half of the sporangium, net bearing prominent, thickened, pulvinate nodes; plasmodic granules deep purple, 1–2 μ in diameter; spores smooth, (6–)7–8 μ in diameter. Plasmodium probably white.

TYPE LOCALITY: Jura Mtns., Switzerland. HABITAT: Very rotten, sodden trunks.

DISTRIBUTION: Switzerland; PIndiana, PLouisiana.

In his original description, Meylan states that C. lepida has the habit of C. languescens and the color of C. violacea and gives the spore size as 5–6 μ . Our single specimen from the type locality, collected by Meylan, is larger and more robust than any specimens of the former species we have, and quite different in shape and size from the latter, and the spores are 7–7.5 μ in diameter. The spores of the American collections referred here are 6–6.5 μ in diameter, hence in that respect more in accord with the original description than Meylan's collection. The white plasmodium is unusual among Cribrarias but that of C. rufa is reported as white. The species appears to be valid.

Two small collections from Indiana and one from Louisiana are provisionally referred to this species. Two of these developed in moist chambers. They are somewhat smaller than the Swiss material but grade into it as they do not into *C. violacea*. The plasmodium was not seen. They may represent a distinct species, but until more material is available it would be unwise to describe them as such.

Cribraria macrocarpa Schrad., Nov. Gen. Pl. 8. 1797.

Trichia macrocarpa (Schrad.) Poir., in Lam. Encyc. 8: 55. 1808.

Cribraria tatrica Racib., Hedwigia 24: 170. 1885.

Heterodictyon bieniaszii Racib., Hedwigia 28: 121. 1889.

Cribraria bieniaszii (Racib.) Massee, Mon. 60. 1892.

Sporangia gregarious, often crowded, stipitate, erect or nodding, yellowish brown or bronze and iridescent, pear-shaped or ovate, rather large, 0.8–1 mm in diameter, total height 2–3 mm; stalk brown, furrowed, mostly 1–2 times the height of the sporangium, arising from a thin, iridescent hypothallus, expanded above, merging into cup; cup rather deep, marked by numerous dark brown radiating dentate ribs, iridescent, with many perforations in upper part so that it merges gradually with the net; nodes dark from the rather large, 1–2 μ in diameter, plasmodic granules, flat, expanded, irregular, the filaments delicate, often dichotomously branched, the free ends sometimes circinate; spores yellowish in mass, almost colorless by transmitted light, minutely roughened, 5–7 μ in diameter. Plasmodium slate-colored.

TYPE LOCALITY: Germany.

HABITAT: Dead wood, especially of conifers.

DISTRIBUTION: Widely distributed in Europe and North America but not common; also known from Chile, Colombia; Pakistan; Japan.

ILLUSTRATIONS: Schrad., Nov. Gen. Pl. pl. 2, f. 3, 4; Lister, Mycet. ed. 3. pl. 141, a-d; Hattori, Myxom. Nasu pl. 15, f. 6; Acta Bot. Neerl. 13: 141, f. 8.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2900; Thaxter, Rel. Farl. 389.

FIG. 41 Plate IV

FIG. 42 Plate IV The rather dark color, the flat and irregular nodes, and the perforated cup are the marks of this rather uncommon species. Schrader's original illustrations exaggerate the color and the branching of the net somewhat, but Nannenga-Breme-kamp (1964b) shows much the same thing in her figure cited.

It is certain that this species has been misunderstood. The removal of the forms now referred to *C. martinii* Nann.-Brem. has made it possible to define it more precisely.

Cribraria martinii Nann.-Brem., Acta Bot. Neerl. 13: 140. 1964.

Sporangia erect, stipitate, clay-colored to reddish ochraceous, gregarious on an inconspicuous hypothallus, globose, about 0.8 mm in diameter, total height up to 2 mm; stalk dark brown or black, plicate, brittle; cup very delicate, membranous, sometimes nearly or completely lacking and replaced by broad ribs with connections above occupying the lower half of the wall, merging above into a net characterized by small, thickened nodes connected by delicate threads with few or no free ends; dictydine granules small, 1–1.5 μ , dark; spores globose or somewhat angular, minutely warted, clay-colored in mass, pale brown by transmitted light, 5–6.5 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Zeist, Netherlands.

HABITAT: Dead wood, chiefly coniferous.

DISTRIBUTION: Netherlands; Ontario; New Hampshire; Washington.

ILLUSTRATION: Acta Bot. Neerl. 13:140, f. 7.

As noted by the author, this species has been confused with *C. splendens* and *C. macrocarpa*, from both of which it may be distinguished by the small, definitely thickened nodes of the upper part of the net. It is probable that reexamination of specimens referred to these species may show that the distribution of the *C. martinii* is wider than indicated above.

FIG. 43 Plate IV Cribraria microcarpa (Schrad.) Pers., Syn. Fung. 190. 1801, emend. Nann.-Brem. K. Ned. Akad. Wet. Proc. C. 69: 340. 1966.

Dictydium microcarpum Schrad., Nov. Gen. Pl. 13. 1797.

Trichia microcarpa (Schrad.) Poir., in Lam. Encyc. 8: 54. 1808.

Cribraria minima Berk. & Curt., in Berk., Grevillea 2: 67. 1873.

Sporangia scattered or gregarious, reddish ochraceous, globose, stipitate, nodding, 0.1–0.3 mm in diameter; total height 3–4 mm or more; cup usually lacking, or represented by a small basal disk, the net arising directly from the stalk or margin of disk, the meshes mostly rectangular, a few triangular; the nodes strongly thickened, rounded, small, 10–20 μ in diameter, concave on the inner side, dark brown due to dark plasmodic granules 1–2 μ in diameter with which they are filled; the connecting threads delicate, 1–1.5 μ in diameter, transparent, with few or no free ends; stalk dark purplish brown, (0.5–)2–4(–5) mm long, furrowed, slender, tapering upward; spores ochraceous in mass, pale by transmitted light, minutely spinulose, 5–7 μ in diameter. Protoplasmodia at first colorless, becoming white, then dingy brown.

TYPE LOCALITY: Iowa City, Iowa (Neotype).

HABITAT: Dead wood.

DISTRIBUTION: Widely distributed in Europe and North America; also known from Colombia; southern Asia; Japan; West Africa; New Zealand.

ILLUSTRATIONS: Lister, Mycet. ed. 3, pl. 145, d-h; Hattori, Myxom. Nasu pl. 15, f. 4; Acta Bot. Neerl. 13: 143, f. 9; 144, f. 10.

This is our commonest species with small, nodding sporangia and very long, delicate stalks. It is so inconspicuous as to be overlooked easily in the field, but frequently develops on decayed wood in moist chambers. Very small fruitings of *C. languescens* may be confused with this, but can be distinguished by the darker, often coppery color, the larger average size of the sporangia, the relatively shorter stems and especially by the well-developed calyculus.

When wood or bark is put into a petri dish over moistened filter paper, the plasmodia frequently migrate to the paper and may be seen as minute, hyaline disks about 0.5 mm in diameter. They turn white and cease to migrate, then brown and each develops a single sporangium. The process is often very slow and sometimes takes several weeks. The plasmodia of *Clastoderma debaryanum* are almost exactly similar and behave in the same way. The two species often occur together on the same substratum.

Nannenga-Bremekamp (1964b) described collections from the Netherlands as differing in possessing larger and paler dictydine granules, smaller, flatter nodes, and short, thick connecting threads between the nodes. In a later paper (1966a), she segregated these as C. pachydictyon, q.v. The tropical American collections and those from New Zealand are entirely like those from the United States. Schrader's original figure of Dictydium microcarpum, Nov. Gen. Pl., pl. 4, f. 3, 4, suggests C. pachydictyon rather than C. microcarpa, which makes use of the name in Nannenga-Bremekamp's sense somewhat questionable. However, the name has for so long been associated with our common North American species, that it seems best to follow her treatment.

Cribraria minutissima Schw., Trans. Am. Phil. Soc. II. 4: 260. 1832.

Cribraria microscopica Berk. & Curt., in Berk., Grevillea 2: 67. 1873.

Sporangia minute, scattered, stalked, erect, nut-brown or orange-brown, sometimes coppery, 0.1–0.2(–3) mm in diameter; total height rarely exceeding 1 mm; cup variable, when fully mature often separated from the net by a shallow constriction, more commonly the constriction not present, and the cup frequently lacking; nodes expanded but not thickened, bearing pale granules, the connecting threads flattened, free ends lacking; hypothallus none; stalk brown, one to four times the height of the sporangium; spores yellow in mass, pallid by transmitted light, minutely roughened, 6–8 μ in diameter. Plasmodium blackish blue.

TYPE LOCALITY: Pennsylvania.

HABITAT: Dead wood, often among mosses.

DISTRIBUTION: Widely distributed in the United States; Uruguay; Europe; Hawaii; Asia.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 140, d-h; Hattori, Myxom. Nasu pl. 15, f. 5.

Schweinitz's original description emphasized the constricted cup and the expanded reticulum. Berkeley's original description of C. microscopica, although brief, suggests very strongly that that species may well be a synonym of the present species, but that C. minima, commonly cited as a synonym since the treatment of Lister (1894), is more probably one of the small species with slender stem and thickened nodes, possibly C. microcarpa, to which it is provisionally assigned. When a cup is present, it is usually on every sporangium in a fruiting, and, if lacking, it is usually uniformly so. It would be easy to distinguish two species on this basis if one were inclined to do so.

FIG. 44 Plate IV Cribraria oregana H. C. Gilbert, in Peck & Gilbert, Am. Jour. Bot. 19: 142. 1932.

FIG. 45 Plate IV Sporangia gregarious or scattered, stalked, usually erect, but sometimes nodding, dull orange-brown to dark brown, (0.05-)0.2-0.4(-0.6) mm in diameter, stalk subulate, wrinkled, dark brown to black at base, fading to concolorous above, 0.5–1 mm long; total height rarely exceeding 1.5 mm; hypothallus not evident; calyculus one-third to one-half of the sporangium, with ribs not prominent, sometimes scarcely evident, the margin toothed or irregular, bearing many large $(1-2~\mu)$, dark plasmodic granules; net with meshes of variable size with few free ends; nodes variable, essentially flat and expanded, but some large, somewhat thickened and irregular, others smaller; connecting threads mostly delicate and slender, except between the large nodes where they may be broad and filled with granules; spores orange-brown in mass, dull yellow or brownish yellow under the lens, minutely warted, globose, somewhat angular, with a delicate reticulum, $(6.5-)7-8.5(-9)~\mu$ in diameter or sometimes oval and proportionately longer and narrower. Plasmodium dingy grayish black, becoming white before fruiting.

TYPE LOCALITY: Willamette Valley, Oregon.

HABITAT: On decaying coniferous wood, especially of Douglas Fir.

DISTRIBUTION: Washington, Oregon, California, New Jersey.

ILLUSTRATIONS: Am. Jour. Bot. 19; pl. 12, f. 6; Macbride and Martin, Myxom., pl. 14, f. 348, 349.

Characterized by the rather small, dark sporangia with large, irregular, scarcely thickened nodes and relatively large, dingy spores. The species was recognized by Macbride and Martin (1934). The oval spores mentioned by them do occur in the type collection, but are few or lacking in other collections. Hagelstein (1944) included the species under C. minutissima and this disposition was accepted by Martin (1949). However, examination of additional material from the Pacific coast seems to show that such assignment is incorrect. We have adequate material of the type collection. The spores are $8-9~\mu$ in diameter, not reaching $9.5~\mu$, and the cup, as seen under the microscope, is definitely ribbed, although the ribs are scarcely evident under a binocular. Two collections from New Jersey made by Mrs. Allen are tentatively referred here, although the spores are slightly smaller than are those of the western specimens.

Nannenga-Bremekamp (1964b) would include this in C. vulgaris. Both are dusky, but the colors are not the same, the spores of C. oregana are larger and darker, and the species is consistently smaller than C. vulgaris.

Cribraria pachydictyon Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 69: 342. 1966.

Sporangia gregarious, hazel-brown, globose, stipitate, erect or nodding, about 0.2 mm in diameter, total height 1.5–3 mm; cup lacking, the net arising directly from the apex of the stalk, the meshes mostly triangular; the nodes only moderately thickened, 8–10 μ in diameter, only slightly if at all concave on inner side, filled with large, pale dictydine granules 1.5–2.5(–3) μ in diameter, the connecting threads stout, somewhat flattened, pale, 1.5–2.5 μ in diameter, with no free ends; stalk brown, arising from a small hypothallus, tapering upward, 8–13 times the height of the sporangium; spores hazel-brown in mass, pale ochraceous by transmitted light, spinulose, 6.5–8 μ in diameter. Plasmodium gray, becoming hyaline just before fruiting.

TYPE LOCALITY: Doorwerth, Netherlands.

HABITAT: Decaying wood and bark of both conifers and angiosperms.

DISTRIBUTION: Netherlands; Maine.

ILLUSTRATIONS: Acta Bot. Neerl. 13: 143, f. 9 (as C. microcarpa); K. Ned. Akad. Wet. Proc. C. 69: 342, f. 4.

This species, formerly included in *C. microcarpa*, differs from that species as redefined by Nannenga-Bremekamp in its smaller, paler, flatter nodes, filled with pale, large dictydine granules, in the coarser, flatter connecting threads of the net and its slightly larger and somewhat more prominently spinulose spores. An old collection from Maine, put aside as an aberrant fruiting of *C. microcarpa*, appears to belong here, and it is possible that reexamination of other specimens filed as *C. microcarpa* will show that they also may be included.

Cribraria piriformis Schrad., Nov. Gen. Pl. 4. 1797.

Cribraria intermedia Schrad., Nov. Gen. Pl. 4. 1797.

Sporangia gregarious, stipitate, 0.3–0.6 (–0.9) mm in diameter, turbinate or pyriform to globose, erect or nodding, purplish brown; stalk usually comparatively short, 0.5–0.7 mm long, but sometimes up to 2.5 mm, tapering upward, longitudinally furrowed, purple or brown; cup very well defined, occupying one-third of the sporangium, ribbed and marked with minute granular lines, often conical, sometimes flattened or rarely slightly umbilicate below, the margin denticulate, dusky brown; net simple, the meshes large, triangular, with relatively few free ends, the nodes thickened, convex or somewhat flattened, filled with large, dark granules up to 2.5 μ in diameter; spores dull yellow-brown in mass, pale ochraceous or salmon-tinted by transmitted light, with distinct, pallid warts, 6–8 μ in diameter. Plasmodium perhaps pale slate color (Lister).

TYPE LOCALITY: Germany.

HABITAT: Dead coniferous wood.

DISTRIBUTION: Widely distributed in North America, particularly in mountainous regions, but not common; Europe; Japan.

ILLUSTRATIONS: Schrad., Nov. Gen. Pl. pl. 1, f. 2; pl. 3, f. 4, 5; Rost., Mon. pl. 2, f. 14, 24; Lister, Mycet. ed. 3. pl. 144.

EXSICCATI: Brândză, Myxom. Roum. IIb: 26, 46, 47 (NY).

The markedly pyriform shape illustrated by Schrader in his plate 1, fig. 2, illustrating *C. intermedia* and his plate 3, fig. 5, illustrating *C. piriformis*, represents an extreme not observed in our material, although approached by those sporangia with a marked obconical cup. However, in fruitings where such sporangia occur, globose forms are also present.

C. intermedia is said by Schrader to be intermediate between C. piriformis and C. fulva, the latter regarded by Rostafinski (1875), and by others on his authority since that time, as a synonym of C. rufa. On the basis of Schrader's figure, Macbride and Martin (1934) entered it as a synonym of C. piriformis, which seems equally reasonable.

Meylan (1933) recognizes, in addition to the slightly pyriform typical form, three varieties, all globose: notabilis Rex, fuscopurpurea Meylan, and macrocarpoidea Meylan. All three, as well as an apparently unpublished varietal name on a specimen from Torrend, appear to have been applied to specimens well within the legitimate range of variation of a single species.

FIG. 46 Plate V Cribraria purpurea Schrad., Nov. Gen. Pl. 8. 1797.

FIG. 47 Plate V Sporangia gregarious, globose, stipitate, erect, large, (0.3-)0.6-1(-1.2) mm in diameter, reddish purple; stalk concolorous, furrowed, about twice the diameter of the sporangium in length, on a distinct hypothallus; total height 1.5-2.5(-3) mm; calyculus persistent, occupying less than half the sporangium, obscurely ribbed and sometimes marked by concentric plications, the margin toothed; dictydine granules notably large, dark maroon or purple, 2-3(-5) μ in diameter; net poorly differentiated, the meshes and the flat, unthickened nodes irregular in form and size, the threads pale and broad, the free ends short, often numerous; spores rose-purple in mass, pale or colorless by transmitted light, nearly smooth, minutely warted and with an obscure and incomplete reticulation, 5-6.5 (-7.5) μ in diameter. Plasmodium purple-red, becoming scarlet before fruiting, and staining the substratum strongly.

TYPE LOCALITY: Europe.

HABITAT: Dead coniferous wood.

DISTRIBUTION: Widely distributed in Europe, where it is locally common, and in the United States, where it appears to be rather rare; Japan.

ILLUSTRATIONS: Lister, Mycet., ed. 3. pl. 146, a-c.

EXSICCATI: Brândză, Myxom. Roum. IIb: 23, 50, 107(NY); 104(IA).

Similar in color to *C. elegans* but often more purple, and larger, with flattened irregular nodes and notably large, deep maroon or purple dictydine granules. The latter, and the pigments, are similar to those of *Dictydium cancellatum*.

Cribraria rubiginosa Fries, Syst. Myc. 3: 172. 1829.

FIG. 48 Plate V Cribraria rubiginosa var. longipes Meylan, Bull. Soc. Vaud. Sci. Nat. 44: 294. 1908.

Cribraria meylanii Brândză, Bull. Soc. Myc. Fr. 44: 274. 1929.

Sporangia stipitate, ellipsoid or subglobose, 1–2 mm broad, dull crimson when filled with spores, often forming large colonies on a well-developed hypothallus; stalk rugose, dark brown, 0.3–3.5 mm long, 0.2 mm thick; total height of stalked forms up to 5 mm; calyculus iridescent, occupying one-third to one-half the total height of the sporangium, not sharply separated above from the peridial net, marked with numerous curved or horizontal lines, often in a reticulate pattern, and sparsely studded with dark plasmodic granules 1–2 μ in diameter; net iridescent, of slender, red-brown, rigid threads, the nodes scarcely enlarged, the meshes up to 0.1 mm in diameter; spores dull crimson in mass, minutely punctate, 5–6 μ in diameter. Plasmodium purple-black.

TYPE LOCALITY: Sweden.

HABITAT: Dead wood of conifers.

DISTRIBUTION: Sweden, Switzerland, Rumania. ILLUSTRATION: Lister, Mycet. ed. 3, pl. 139.

EXSICCATI: Brândză, Myxom. Roum. 25, 52, 123, 124(NY).

In the original description, Fries says "stipite brevissimo" and that is the way it is shown in Lister's illustration. Meylan proposed the variety longipes for forms collected in wet mountain ravines in Switzerland, mainly on the basis of the rather long stems. Brândză reported the variety as abundant in Moldavia and raised it to species rank on the basis of the stem character and a few additional and very minor differences which do not seem to transcend the expected variation in a

species. Our only material is from Switzerland, collected by Meylan and representing the long-stalked form, hence that is illustrated. It is possible that two species really are involved here. Pending further information, however, it seems best to recognize only one species for these forms.

Cribraria rufa (Roth) Rost., Mon. 232. 1875.

Stemonitis rufa Roth, Fl. Germ. 1: 548. 1788.

Cribraria rufescens Pers., Neues Mag. Bot. 1: 91. 1794.

?Cribraria fulva Schrad., Nov. Gen. Pl. 5. 1797.

Trichia rufescens (Pers.) Poir., in Lam. Encyc. 8: 55. 1808.

Sporangia gregarious, subglobose or turbinate, stipitate, erect, dull brick-red or reddish orange, mostly 0.4–0.7(–1) mm in diameter, sometimes much smaller; stalk about equalling the height of the sporangium, sometimes much longer, dark brown or black; cup one-third to one-half the sporangium, the margin toothed, the wall ribbed and continuous with the open, wide-meshed net; net yellow or orange, the threads flattened, the nodes small or expanded but only occasionally thickened, bearing large, pale granules about 2 μ in diameter, free ends few; spores reddish ochraceous to dull red in mass, dull yellow by transmitted light, slightly angular, verruculose, (6–)7–9 μ in diameter. Plasmodium white.

TYPE LOCALITY: Germany.

HABITAT: On dead wood, mainly of conifers.

DISTRIBUTION: Widely distributed throughout Europe and in the United States and Canada; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 140, a-c; Acta Bot. Neerl. 13: 145, f. 11.

EXSICCATI: Jaap, Myxom. Exs. 15, 52; Brândză, Myxom. Roum. 51, 98(NY).

We have many collections from the western United States referred to this species. Few of them suggest the species as illustrated by Lister and Nannenga-Bremekamp. Most of them are erect, on stems 2–3 times the height of the sporangium. Some are better referred to C. dictyospora, or to C. atrofusca or C. oregana, if the two latter species are to be recognized, but many of them pass by a series of gradations into specimens essentially the same as Jaap's German collections. The spores of all are relatively large for Cribrarias and none have been seen smaller than 6 μ . Many of the western collections do suggest C. fulva Schrad., as illustrated in his plate 1, fig. 1, although neither the description nor the illustration permit any certainty as to what Schrader had.

The Lister monograph compares this with C. minutissima, with which it does have much in common although it is much larger and the colors are usually quite distinct. The spores as illustrated by Nannenga-Bremekamp are about 8–8.5 μ as checked by her scale and she shows a very faint reticulum. While we have not seen that, the slightly angular spores suggest that it may be present.

Cribraria splendens (Schrad.) Pers., Syn. Fung. 191. 1801.

Dictydium splendens Schrad., Nov. Gen. Pl. 14. 1797.

Trichia splendens (Schrad.) Poir., in Lam. Encyc. 8: 55. 1808.

Sporangia gregarious, globose, 0.3-0.7 mm in diameter, erect or nodding, ochraceous when filled with spores, dull or dusky brown when these are discharged, stipitate; stalk usually rather short, sometimes 3-4 or more times the diameter of the sporangium, subulate, purplish brown; hypothallus small, total

FIG. 49 *Plate* V

FIG. 50 Plate V height 1.5–2(–3) mm; net brown, with large meshes, irregular, flattened or slightly thickened nodes and flattened threads; dictydine granules small, 0.5–1 μ in diameter; cup lacking, its place supplied by usually eight to fifteen distinct, firm ribs which radiate from the stipe and support the net, branching to blend with its reticulations, occasionally partially connected by delicate, hyaline membranes at the base; spores ochraceous in mass, colorless by transmitted light, smooth or nearly so, 6–7 μ in diameter. Plasmodium lead-colored.

TYPE LOCALITY: Germany. HABITAT: Dead wood.

DISTRIBUTION: Widely distributed in Europe; in North America, especially in western coniferous forest areas; Asia.

ILLUSTRATIONS: Schrad., Nov. Gen. Pl. pl. 4, f. 5, 6; Lister, Mycet. ed. 3. pl. 141, e-h.

EXSICCATI: Jaap, Myxom. Exs. 180.

Cribraria splendens var. jurana Meylan, was described as without nodes. A specimen from Meylan in the New York Botanical Garden, No. 9169, has nodes. The form seems unworthy a name. The nodes are sometimes somewhat thickened, but the ribs radiating from the tip of the stalk, particularly in old sporangia, usually make this species easy to recognize. Nearly all of our specimens are from the Pacific coast, but Hagelstein's 2798, from Pennsylvania, is typical.

Cribraria tenella Schrad., Nov. Gen. Pl. 6. 1797.

FIG. 51 Cribraria elata Massee, Mon. 61. 1892.

Plate V

Sporangia gregarious, globose, mostly 0.3–0.5 mm in diameter, olivaceous or ochraceous, long-stipitate, erect or nodding; stalk slender, dark brown or blackish, 3–6 times the diameter of the sporangia in length, the longer stems tending to be weak and flexuous; calyculus present or absent, when present, delicate but well-defined, shallow, brown, costate but not toothed, occasionally with the costae only partially connected by the thin translucent membrane, cup not rarely completely lacking; net well-differentiated, the meshes small, regular, the nodes small, dark, prominent, rounded, connected by 4–5 transparent threads, free ends few; dictydine granules brown, 0.5–2 μ in diameter, spores olivaceous or ochraceous in mass, pallid by transmitted light, globose, almost smooth, 5–7 μ in diameter. Plasmodium brownish black according to some reports, hyaline and nearly colorless in others.

TYPE LOCALITY: Germany.

HABITAT: Dead wood.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Schrad., Nov. Gen. Pl. pl. 3, f. 2, 3; Lister, Mycet. ed. 3, pl. 143, f-i.

Schrader compared this species with C. aurantiaca, noting that it differed in the darker cup with smooth, not toothed, margin, the equal, regular nodes and in its generally smaller and more slender habit. Lister and Hagelstein say it merges with C. intricata, but the small regular nodes, the smaller size and the general neat and slender appearance are not suggestive of that species. The stalk varies greatly in length, but in general is relatively long and slender. The cup is very delicate and in the same fruiting one may find adjacent sporangia with and without a cup. The species is somewhat difficult to define, but when well matured, appears to be constant.

FIG. 52 Plate V

Cribraria violacea Rex, Proc. Acad. Phila. 43: 393. 1891.

Sporangia scattered or gregarious, stipitate, erect, deep purple to purplish bronze, shining with metallic luster, 0.1–0.3(–0.5) mm broad, their total height 0.5–2 mm; stalk usually two-thirds to four-fifths of the total height but sometimes much more, slender, tapering upward, concolorous or darker; cup crateriform to urniform, persistent, occupying one-half to two-thirds of the sporangium, marked with minute plasmodic granules, 1–1.5 μ in diameter; net open, the meshes few, irregular, the nodes somewhat thickened, but flat, angular, broadly expanded; spores bright violet in mass, lilac by transmitted light, minutely warted, 7–8 μ in diameter. Plasmodium purplish black.

TYPE LOCALITY: Philadelphia, Pennsylvania.

HABITAT: Dead wood, bark of living and dead trees, and on mosses.

DISTRIBUTION: Widely distributed and common in North America; cosmopolitan, but apparently less common elsewhere.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 146, g-i; Macbr. & Mart., Myxom., pl. 14, f. 363, 364; Hattori, Myxom. Nasu, pl. 23, f. 2.

The small, erect, deep purple sporangia, with deep calyculus, very open net, and large, flat, angular nodes, make this a distinctive and easily recognized species. Specimens of the same deep purple color, but with long, slender stems, shallow cups, small, thickened, pulvinate nodes and nodding sporangia have been obtained from Indiana and Louisiana. These are provisionally referred to C. lepida Meylan, although they are very small for that species.

The dark color and small size make this species rather inconspicuous in the field. It appears very often in moist chambers, especially on elm.

Cribraria vulgaris Schrad., Nov. Gen. Pl. 5. 1797.

Sporangia gregarious, globose, stipitate, erect or nodding, nut-brown, becoming dusky, 0.4–0.7 mm in diameter; total height 1–2 mm; stalk subulate, dark, 2–3 times the height of the sporangium; cup usually prominent, occupying about one-third to two-fifths of the lower portion of the sporangium, brown, marked by delicate radiating veins, the margin irregular, bearing coarse, angular, spiny teeth which bear the net; net irregular, the nodes pale, broad, flat-pulvinate, branching and angular, the threads slender, with few free ends; dictydine granules dark, 1–2 μ in diameter; spores bright yellow to bright ochraceous in mass, colorless by transmitted light, minutely punctate, 5–6 μ in diameter. Plasmodium slate-gray or greenish.

TYPE LOCALITY: Germany.

HABITAT: Dead wood.

DISTRIBUTION: Europe, southern and eastern Asia; southern Canada and the United States.

ILLUSTRATIONS: Schrad., Nov. Gen. Pl. pl. 1, f. 5; Lister, Mycet. ed. 3. pl. 142, f. a, d; Acta Bot. Neerl. 13: 146, f. 12.

EXSICCATI: Brândză, Myxom. Roum. 53(NY); 105(IA).

As noted under *C. aurantiaca*, the careful study of Nannenga-Bremekamp (1964b) has permitted a more accurate delimitation of this species than was previously possible, but at the same time makes distribution data less reliable.

G. Lister (1925) cites C. intermedia Berk., in Smith, Engl. Fl. 5(2): 296. 1836, as a definite synonym of C. vulgaris. If C. intermedia Berk. was published as new, it is a later homonym of C. intermedia Schrad. In the same work, C. variabilis

Ficin. & Schub., Fl. Dresden 2: 296. 1823, and Sphaerocarpus semitrichioides Bull., Champ. Fr. 125. 1791, pl. 387, f. 1, are cited as possible synonyms.

EXCLUDED AND DOUBTFUL SPECIES

Cribraria badia Chev., Fl. Par. 1: 328. 1826.

Original not seen. Description in Sacc. Syll. Fung. 7: 417. 1888, does not permit recognition.

Cribraria candida Rab., in Colmeiro, Enum. Crypt. Esp. I. 37. 1867, not seen. Probably not validly published.

Cribraria capillaris Fries, Stirp. Fems. 84. 1827.

Cited in Lister, Mon. ed. 3: 177, as possible synonym of C. microcarpa. Not cited by Fries in the Systema.

Cribraria coccinea Pers., Syn. Fung. 190. 1801.

Persoon cited Sphaerocarpus trichioides Bull., Hist. Champ. Fr. 124. 1791, pl. 387, f. 2 (1789). Probably a Cribraria but not otherwise recognizable.

Cribraria didermoides Schum., Enum. Pl. Saell. 2: 218. 1803.

Uncertain. Cited by Fries, Syst. Myc. 3: 165. 1829, as the basionym of Dictydium didermoides (Schum.) Fries.

Cribraria exigua Meylan, Bull. Soc. Vaud. Sci. Nat. 57: 304. 1931.

A small species with spores 7–9 μ , resembling C. rufa, with which it should be compared.

Cribraria intermedia Berk., in Smith, Engl. Fl. 5(2): 296. 1836.

Attributed to Berkeley by Cooke, Berlese and Lister, and cited in Lister Mon. ed. 3: 173 as synonym of *C. vulgaris*. Original publication not seen; possibly intended as citation of *C. intermedia* Schrad.

Cribraria lycopodii Nees, "in litt."

Cited by Fries, Syst. Myc. 3: 163. 1829, as synonym of Stemonitis cribra-rioides Fries. Not validly published.

Cribraria onygena Schum., Enum. Pl. Saell. 2: 219. 1803.

Not a myxomycete. Probably *Phleogena decorticata* (Schw.) Martin (Phleogenaceae).

Cribraria stellata Schum., Enum. Pl. Saell. 2: 219. 1803.

Doubtful. Lister Mon. ed. 3: 259.

Cribraria straminiformis Speg., "Fungi Arg. Pugillus II, No. 109." So cited by Massee, Mon. 335. 1892, as synonym of Tilmadoche gyrocephala Rost., i.e. Physarum polycephalum Schw.

Cribraria variabilis Ficin. & Schub., Fl. Dresden 2: 296. 1823.

Cited in Lister, Mon. ed. 3: 173, as possible synonym of C. vulgaris.

Cribraria venosa (Schrad.) Pers., Syn. Fung. 191. 1801.

Based on Dictydium venosum Schrad., q.v.

Dictydium

Schrad., Nov. Gen. Pl. 11. 1797.

Heterodictyon Rost., Versuch 5. 1873.

Sporangiate, stalked, the sporangia globose or subglobose, often umbilicate above or below, or both. Peridium delicate, usually evanescent above and more tardily below, except for the net and a basal portion which may remain as a calyculus. Dictydine granules prominent, usually dark, densely aggregated on all parts of the net, the calyculus, when present, and on the spores. Net composed of stout longitudinal ribs connected by delicate transverse filaments, especially below, the upper portion sometimes more or less netted, as in *Cribraria*, without thickened nodes.

Type species, Dictydium umbilicatum Schrad.

Although he does not specifically say so, Schrader apparently made the absence of a calyculus the distinctive feature by which he distinguished *Dictydium* from

Cribraria and it was not until Rostafinski's treatment of 1875 that the current application of these names was adopted. Nannenga-Bremekamp (1964a) merged Dictydium with Cribraria, pointing out that neither presence nor absence of a calyculus is constant, and that the net of Dictydium merges into that of Cribraria. There is much merit in this disposition, but similar problems occur in other genera. In the present case, Dictydium is about as constant as many of these other genera, its only common species is readily recognized by the naked eye, and it seems more convenient to retain such a familiar and well-known genus.

KEY TO SPECIES

 Surface net strongly ribbed below, merging above into a coarse reticulum; transverse filaments sparse; peridium tending to persist as an irregular membrane.

D. mirabile

a. Ribs of surface net persisting nearly or quite to apex, connected by numerous delicate transverse filaments; reticulations, if present, restricted to tip.

b

- Reddish purple to deep purple or brown; sporangia usually nodding, often umbilicate above and below, with 30 or more ribs; stalk attenuated above, often tortuous. D. cancellatum
- Bright carrot-red; sporangia usually erect, with 14-16 longitudinal ribs; stalk cylindrical.

D. rutilum

Dictydium cancellatum (Batsch) Macbr., N. Am. Slime-Moulds 172. 1899.

Mucor cancellatus Batsch, Elench. Fung. Contin. 2: 135, 1789.

Stemonitis cancellata (Batsch) J. F. Gmel., Syst. Nat. 2: 1468. 1791.

Cribraria cernua Pers., Obs. Myc. 1: 91. 1796.

Dictydium umbilicatum Schrad., Nov. Gen. Pl. 11. 1797.

Trichia cernua (Pers.) Poir., in Lam. Encyc. 8: 54. 1808. Not T. cernua Schum., 1803.

Dictydium cernuum (Pers.) Nees, Syst. Pilze Schw. 120. 1817.

Cribraria trichioides Chev., Fl. Par. 1: 327. 1826.

Cribraria exilis Macbr., Bull. Nat. Hist. Univ. Iowa 2: 378. 1893.

Dictydium longipes Morgan, Jour. Cinc. Soc. Nat. Hist. 15: 143. 1893.

Dictydium umbilicatum var. anomalum Jahn, Ber. Deut. Bot. Ges. 19: 99. 1901 (as "variety" Dictydium anomalum).

Dictydium anomalum (Jahn) Meylan, Bull. Soc. Vaud. Sci. Nat. 44: 295. 1908. Cribraria cancellata (Batsch) Nann.-Brem., Acta Bot. Neerl. 11: 22. 1962.

Gregarious, often in extensive fruitings; sporangia stipitate, depressed-globose, umbilicate below and usually above, deep reddish brown or brownish purple, varying to bright purple or rufous, (0.3-) 0.4–0.7 mm in diameter; stalk subulate, usually long, pale above, shading to concolorous or dark below and twisted at top, less commonly, short and then dark and erect, 1–8 times the diameter of the sporangium; total height 1–5 mm; peridium largely fugacious, leaving thickenings in the form of stout longitudinal ribs connected by delicate transverse bands, so that the meshes are almost rectangular on the sides but may be polygonal or irregular at apex and base; cup present or absent, if present, usually shallow; dictydine granules large, dark; spores reddish or purplish in mass, pale red by transmitted light, globose, nearly smooth, 5–7 μ in diameter. Plasmodium purple-black.

TYPE LOCALITY: Germany. HABITAT: Dead wood.

FIG. 54 Plate VI DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Batsch, Elench. Fung. Contin. 2: pl. 42, f. 232 a-c; Schrad.,
Nov. Gen. Pl. pl. 4, f. 1, 2; Rost., Mon. pl. 2, f. 16-19, 22; Jour. Cinc. Soc.
Nat. Hist. 15: pl. 3, f. 12; Ber. Deut. Bot. Ges. 19, pl. 5; Lister, Mycet. ed. 3. pl. 147; Macbr. & Mart., Myxom. pl. 15, f. 371, 372; Hattori, Myxom. Nasu pl. 10, f. 2; Nat. Geog. Mag. 49(4): pl. 13.

EXSICCATI: Ellis, N. Am. Fungi 1122; Jaap, Myxom. Exs. 35, 159, 199; Brândză, Myxom. Roum. I. 1: 19, 20; II. 1: 56(NY); 103(IA).

This extremely common and widely distributed species shows even more than the usual range of variation that is commonly found in such species. Schrader, in establishing the genus, recognized five species, four of which are now referred to Cribraria. His illustration of D. umbilicatum, pl. 4, f. 1, applies unquestionably to what is now called D. cancellatum and shows sporangia both with and without a calyculus. The color varies greatly, the commonest form being a reddish purple but other collections are paler or more purple and some are brown. Since these are connected by a complete series of intermediate shades, varietal names based on color are of little, if any, significance. Occasional collections are more or less netted above, sometimes strikingly so, and such specimens have been confused with the alpine forms referred by Rostafinski to his genus Heterodictyon, but, as noted under the discussion of D. mirabile, they appear clearly to fall within the range of variation of the present species.

Cribraria exilis Macbr., Bull. Nat. Hist. Univ. Iowa 2: 378. 1893, may belong here. Macbride thought it more closely related to what is here called *D. mirabile*, but his description and illustration suggest an aberrant form of *D. cancellatum*. The type material should be at Iowa, but has not been found.

Few species have had so many subspecific taxa described, and many of these have been commonly used, not always consistently and rarely helpfully. Since they have been published it seems desirable to list those not included in the synonymies of this species and *D. mirabile* even though their application is often uncertain and their significance very doubtful.

Dictydium cancellatum var. cancellatum. In Macbr., N.A. Slime-Moulds 173. 1899. Restricted to brownish fruitings with long stems and small meshes in net.

Dictydium cancellatum var. purpureum Machr., N.A. Slime-Moulds 173. 1899. For purplish fruitings with short stems and an open net.

Dictydium cernuum var. laxum Berk. & Curt., Grevillea 2: 67. 1873. With open net and large, pale spores. Size of spores not given.

Dictydium cancellatum var. fuscum (A. Lister) G. Lister, Mycet. ed. 2. 185. 1911. Dictydium cancellatum var. prolatum Macbr., N.A. Slime-Moulds ed. 2. 232. 1922. Ellipsoidal, without calyculus.

Dictydium cancellatum f. anomalum (Jahn) G. Lister, Mycet. ed. 3. 179. 1925, in part.

Dictydium cancellatum subsp. fuscum (A. Lister) Meylan, Bull. Soc. Vaud. Sci. Nat. 59: 485. 1937.

Dictydium cancellatum subsp. anomalum (Jahn) Meylan, Bull. Soc. Vaud. Sci. Nat. 59: 485. 1937.

Dictydium cancellatum subsp. anomalum f. longisetum Meylan, Bull. Soc. Vaud. Sci. Nat. 59: 485. 1937.

Dictydium cancellatum subsp. anomalum var. purpureum (Macbr.) Meylan, Bull. Soc. Vaud. Sci. Nat. 59: 485. 1937.

Dictydium umbilicatum var. fuscum A. Lister, Jour. Bot. 36: 12. 1898. For brown fruitings with symmetrical cup.

Dictydium umbilicatum subsp. anomalum (Jahn) Meylan, Bull. Soc. Bot. Genève 2: 265. 1910, in part.

Dictydium umbilicatum var. exile (Macbr.) Meylan, Bull. Soc. Bot. Genève 2: 264, 1910.

Dictydium umbilicatum var. genuinum. Meylan, Bull. Soc. Bot. Genève 2: 265. 1910.

Dictydium umbilicatum f. purpureum (Macbr.) Meylan, Bull. Soc. Bot. Genève 2: 265. 1910.

Dictydium umbilicatum f. venosum Meylan, Bull. Soc. Bot. Genève 2: 265. 1910.

Dictydium mirabile (Rost.) Meylan, Bull. Soc. Vaud. Sci. Nat. 57: 305. 1931. Heterodictyon mirabile Rost., Mon. 231. 1875.

Cribraria mirabilis (Rost.) Massee, Mon. 60. 1892.

Dictydium umbilicatum subsp. anomalum var. cribrarioides Meylan, Bull. Soc. Bot. Genève 2: 265. 1910.

Dictydium umbilicatum subsp. anomalum var. heterodictyon (Rost.) Meylan, Bull. Soc. Bot. Genève 2: 265. 1910.

Dictydium cancellatum var. alpinum G. Lister, Mon. ed. 2. 185. 1911, in part. Sporangia stalked, globose, erect, gregarious or closely aggregated, yellow-brown to dark, often purplish brown, 0.5–0.8 mm in diameter, up to 2 mm in total height; peridial net originating as 30 or more strong ribs, often united by a membrane forming a more or less fugacious calyculus occupying the lower third, the upper part becoming a Cribraria-like network, without nodal thickenings, the connecting membrane often persisting in part as an iridescent wall; stalk dark, cylindrical, rarely more than twice the diameter of the sporangium; plasmodic granules dark, conspicuous, $1.5-2~\mu$ in diameter, densely massed on and in the ribs and strands of the net and on the spores; spores reddish brown in mass, hyaline, rather dark by transmitted light, mostly $5.5-7~\mu$ in diameter. Plasmodium unknown.

TYPE LOCALITY: Germany.

HABITAT: Decayed wood of conifers.

DISTRIBUTION: Mountains of central Europe, Sweden; California.

ILLUSTRATIONS: Rost., Mon. pl. 2, f. 16 (as Heterodictyon mirabile); Lister, Mon. ed. 3, pl. 147, f-h (as Dictydium cancellatum var. alpinum: Drawn from type of Heterodictyon mirabile); Acta Soc. Bot. Pol. 11; Supp. pl. 6, f. 17.

This species has a complicated history. It is certainly intermediate between Cribraria and Dictydium but appears to be closer to the latter. Rostafinski erected a separate genus for it, but nearly all later authors have regarded it as a phase of Dictydium cancellatum induced by cold. Certainly forms of D. cancellatum showing a net-like development in the upper part of the capillitium are not unusual, often occurring with typical sporangia. Such a development was described by Jahn (1901) as D. cancellatum var. anomalum and was raised to subspecies rank by Meylan (1937), and it has been generally regarded as the same as the present species. This, we believe, is not the case. The species described as H. mirabile by Rostafinski occurs in mountainous areas in Europe and the United States and seems to be essentially constant in both areas and easily distinguished from D. cancellatum, not only by its erect habit, short stalks and surface net but by its curious, more or less fugacious calyculus, strongly suggesting that of Cribraria splendens.

Meylan (1937) emphasizes the brown rather than purple colors, but of two of his collections examined, one is yellowish brown and iridescent, the other is as fuscous as many specimens of *D. cancellatum*. Collections by W. B. Cooke from Mt. Shasta, California, typical in every respect, are fuscous. Jaap's No. 159, collected by Sturgis in Colorado, is short-stemmed and erect, but seems to be a true example of the possible effect of cold on *D. cancellatum*. This may be similar to the Colorado collection cited by G. Lister as an example of her var. *alpinum*.

FIG. 55 Plate VI Dictydium rutilum G. Lister, Jour. Bot. 71: 222. 1933.

FIG. 56 Plate VI Cribraria rutila (G. Lister) Nann.-Brem., Acta Bot. Neerl. 11: 22. 1962.

Sporangia stalked, subglobose, carrot-colored, 0.3–0.7 mm in diameter, erect; peridial net of 14–16 dark brown ribs connected by a few delicate transverse threads, anastomosing above to form a *Cribraria*-like net; stalk dark brown, cylindrical, not notably attenuated above, 0.6–2.2 mm high; total height 0.6–2.9 mm; calyculus, when present, shallow, membranous, orange-red, often lacking; plasmodic granules dark, minute, 0.3–0.5 μ in diameter, imbedded in the ribs; spores globose, minutely roughened, dull orange or carrot-colored in mass, yellow by transmitted light, 6–7 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Sydney, Australia.

HABITAT: Decayed wood.

DISTRIBUTION: Known only from the type locality, where it is said to be not uncommon.

The color of the spore mass is similar to that of *Cribraria rufa*, but the net is that of *Dictydium*. None of the many variants of *D. cancellatum* has spores of similar color. The color and the small number of principal veins distinguish this species clearly.

EXCLUDED AND DOUBTFUL SPECIES

Dictydium ambiguum Schrad., Nov. Gen. Pl. 13, pl. 4, f. 2. 1797.

Probably a *Cribraria*. Only the stalks and lower portions of the peridia are shown in Schrader's figure. Rostafinski, Mon. 230. 1875, cited it as a synonym of *D. cernuum* (Pers.) Nees, citing Nees's f. 117, which probably does represent *D. cancellatum* but does not agree with Schrader's figure or description of *D. ambiguum*. As noted by Meylan, Bull. Soc. Vaud. Sci. Nat. 57: 484. 1937, the application of the name must remain in doubt.

Dictydium didermoides (Schum.) Fries, Syst. Myc. 3: 165. 1829.

Based on Cribraria didermoides Schum., q.v.

Dictydium micropus Fries, Syst. Myc. 3: 167. 1829.

Cited by Berlese, in Sacc. Syll. Fung. 7: 411. 1888, as synonym of D. venosum Schrad., itself doubtful. See below.

Dictydium venosum Schrad., Nov. Gen. Pl. 14, pl. 3, f. 6. 1797.

Cribraria venosa (Schrad.) Pers., Syn. Fung. 191. 1801. See comments by Fries, Syst. Myc. 3: 168. 1829. Cited in Lister, Mon. ed. 3. 179 as possible synonym of *D. cancellatum f. anomalum* Jahn, Ber. Deutsch. Bot. Ges. 19: 19. 1901. Meylan, Bull. Soc. Vaud. Sci. Nat. 59: 484. 1937, discussed the question and concluded that the application of the name cannot be decided.

ECHINOSTELIALES

Martin, Mycologia 52: 127. 1961.

Sporangia globose, stalked, minute, bright-colored; columella usually present, cylindrical, fusiform or conical, sometimes lacking; capillitium varying from a complete open net to a few branched meshes or lacking. Peridium delicate, early fugacious except at base which may remain as a collar. Spores white, pale pink or yellow to ochraceous or brown in mass, nearly colorless by transmitted light. Protoplasmodia colorless or pinkish.

With a single family.

Echinosteliaceae

Rost., Versuch 7. 1873 (as Tribus).

With the characters of the order.

A single genus.

Echinostelium

de Bary, in Rost., Versuch 7. 1873.

Heimerleia Höhnel, Ann. Mycol. 1: 391. 1903.

With the characters of the family.

Type species, Echinostelium minutum de Bary.

The genus Echinostelium is now one of the better known genera of the Myxomycetes (Alexopoulos 1958, 1960, 1961; B. Ing. 1965). Its traditional position in the Stemonitales has always been anomalous, and Martin (1961) gives reasons for placing it in a separate order. His arguments are fortified by the characteristic spore characters, which are common to at least four of the five known species and unlike those of any other Myxomycetes. These spores are smooth in outline, but under high powers of the microscope the wall is seen to be characterized by more or less circular plate-like areas. The protoplasmodia of all species have been observed in culture. They are minute and amoeba-like, each giving rise to a single fructification.

There are several records of the collection of *E. minutum* in the field; however, most of our knowledge of that species, and all we know of the others, is based on material which has appeared in moist chambers.

Endodromia Berk., Jour. Bot. & Kew Misc. 3: 79. 1841, with its single species E. vitrea Berk., may have been Echinostelium, as suggested by Höhnel, Sitz.-Ber. Akad. Wien 123: 97. 1914. The evidence is too uncertain to justify adoption of Berkeley's name.

- a. Capillitium present; fructifications 0.3 mm or more tall.
- a. Capillitium lacking; fructifications under 0.2 mm tall.
 - Pale pinkish or yellowish to white;
 capillitium scanty, with few or no
 meshes, the ends mostly free; spores 6-9 μ.

E. minutum

b

С

b. Ochraceous; capillitium a complete net, with few or no free ends; spores 9–10 μ .

E. cribrarioides

 Columella well-developed, brown, fragile; spores pink or gray, mostly 13–14 μ.

E. fragile

c. Columella lacking or very small and inconspicuous; spores smaller.

 \mathbf{d}

 d. Sporangia golden yellow, fading to white; spores yellow or white, 6.5–8 μ.

E. elachiston

d. Sporangia rosy, not fading; spores pinkish, 9–10 μ .

E. roseum

Echinostelium cribrarioides Alexop., Am. Midl. Nat. 66: 391. 1961.

FIG. 57 Plate VI Sporangia globose, stipitate, pale ochraceous, scattered or gregarious, 85–120 μ in diameter, 0.3–0.5 mm tall; peridium fugacious except for a persistent basal collar; stalk subulate, dark brown to nearly colorless, expanded below and filled with granular material; columella 4–20 μ in height, sharply delimited from stalk by the collar; capillitium forming a complete globose net with large meshes, sometimes with one or more free ends; spores cream colored in mass, colorless by transmitted light, the wall smooth, but conspicuously thickened in several approximately equally distributed areas, 9–10 μ in diameter. Protoplasmodium colorless.

TYPE LOCALITY: Attica, Greece.

HABITAT: On bark from living trees in moist chambers.

DISTRIBUTION: Greece; Dominica.

ILLUSTRATION: Am. Midl. Nat. 66: 393, f. 1-4.

The capillitium, after spore dispersal, bears a striking resemblance to a very open peridial net of a *Cribraria*. It is, however, a true capillitium, developed internally.

Echinostelium elachiston Alexop., Mycologia 50: 52. 1958.

FIG. 58 Plate VI Sporangia scattered or gregarious, total height 0.12–0.15 mm, globose, 40–50 μ in diameter, erect or nodding, golden yellow, sometimes fading to cream color or white; stipe hair-like, golden brown, darker toward the base, expanded below, its surface rough near the apex, 60–95 μ long; peridium very thin, transparent, usually evanescent at a very early stage, leaving a definite collar attached to the tip of the stipe; columella absent or, if present, minute, conical; capillitium absent; spores globose, typically golden yellow but often white, smooth, but with well-marked circular areas on the wall, 6.5–8 μ in diameter, easily dispersed as a mass of spores which often tend to cling together. Protoplasmodium colorless.

TYPE LOCALITY: Thessaly, Greece.

HABITAT: Bark of trees. All known collections developed in moist chambers. DISTRIBUTION: Widely distributed in Greece; Georgia, Florida, Texas, Missouri, Kansas, Colorado; Jamaica.

ILLUSTRATION: Mycologia 50: 53, f. 1.

This and *E. fragile* are among the smallest of known Myxomycetes and would be detected in the field only under most exceptional circumstances. Bark cultures from other areas may be expected to produce both species.

Echinostelium fragile Nann.-Brem., Acta Bot. Neerl. 10: 65. 1961.

Sporangia stalked, globose, erect or nodding, very pale pink or salmon, becoming brownish, minute, 30–50 μ in diameter, total height 0.13–0.15 mm, stalk tapering, colorless, sometimes slightly striate, with included matter at the base; peridium evanescent except for a minute persistent collar at the base of the sporangium; capillitium lacking; columella brown, fusiform, about 6 μ long; spores subglobose, pale pink or gray in mass and by transmitted light, smooth, with a small thinner area (12–)13–14(–15) μ in diameter. Protoplasmodium pale pink, hyaline.

TYPE LOCALITY: Gelderland, Netherlands.

HABITAT: On bark of Aesculus in moist chambers.

DISTRIBUTION: Netherlands, Ireland, England; Michigan.

ILLUSTRATION: Acta Bot. Neerl. 10: 65, f. 4.

The very minute size, the fusiform columella and the large spores mark this species. Dr. Brooks has found it in Michigan.

Echinostelium minutum de Bary, in Rost., Mon. 215. 1874.

Heimerleia hyalina Höhnel, Ann. Mycol. 1: 391. 1903.

Sporangia stipitate, scattered or gregarious, globose, 40–50 μ in diameter, 0.3–0.5 mm tall, pale pinkish or white; stipe hair-like, white, subulate, expanded below and filled with granular material; columella very short, not exceeding 10 μ in height; capillitium scanty, several times forked with hooked free ends; spores pinkish or white in mass, pallid by transmitted light, nearly smooth, 7–8 μ in diameter. Protoplasmodium colorless.

TYPE LOCALITY: Frankfort, Germany.

HABITAT: Bark of trees, dead wood, dung and litter.

DISTRIBUTION: Europe; eastern United States; Texas, Arizona; Mexico; Jamaica; Central and South America; Queensland; probably cosmopolitan. ILLUSTRATIONS: Rost., Mon. pl. 4, f. 53, 54, 58, 68; Lister, Mycet. ed. 3, pl.

128, f-i; Macbr. & Mart., Myxom. pl. 21, f. 552, 553.

This was known for many years only from the original description. It has now appeared so frequently in so many cultures from so many widely scattered areas that it may be regarded as probably world-wide in distribution.

Echinostelium roseum B. Ing, Trans. Brit. Mycol. Soc. 48: 650. 1965.

Sporangia globose to short-cylindrical, stipitate, erect, bright pink, 32–35 μ in diameter, total height 0.06–0.07 mm; stalk subulate, narrowing upward, white, granular, about half the total height; peridium thin, transparent, persistent; columella and capillitium lacking; spores few (20–24) to a sporangium, globose, pale pink with distinct areoles, 9.1–10.3 μ in diameter, dispersed as a

FIG. 59 Plate VI

FIG. 60 Plate VI mass and tending to cling together. Protoplasmodium clear pink, not darkening before fruiting.

TYPE LOCALITY: Perthshire, Scotland.

HABITAT: On mosses growing on wood in a moist chamber.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATION: Trans. Brit. Mycol. Soc. 48: 649, Fig. 1.

This is the smallest of the Echinostelia and the smallest known undoubted myxomycete. Despite its minute size, the description suggests that it may be fairly obvious when seen under a binocular microscope. It is clearly distinct from any other known species.

TRICHIALES

Macbride, N. A. Slime-Moulds, ed. 2, 237, 1922.

Plasmodiocarpous or sporangiate, sessile or stalked; columella never present; spores in mass typically bright-colored, white to yellow, orange or red in mass, hyaline to bright colored by transmitted light (blackish brown in mass and dusky by transmitted light in *Listerella*); capillitium always present, threadlike, solid or tubular, smooth or sculptured, free or attached.

KEY TO FAMILIES

 Capillitium of solid threads, attached to base and often to sporangial walls, never united into a net.

Dianemaceae

a. Capillitium of tubular threads, free or attached to base of sporangium, often united into a net.

Trichiaceae

Dianemaceae

Macbride, N. Am. Slime-Moulds 180. 1899 (as Dianemeae)

Plasmodiocarpous or sporangiate, rarely short-stipitate; peridium usually single or with a granular outer layer; capillitium composed of threads which are either solid or with a restricted lumen, smooth, or with minute sculpturing or, in *Listerella*, moniliform, and either coiled and hair-like or nearly straight, attached to the base of the fructifications and usually to the peridium or cortex, simple or sparsely branched, but never forming a net.

The Dianemaceae of Macbride, 1899, is, in modern usage, essentially the same as the Margaritaceae of the Lister monographs. However, since *Margarita* A. Lister, when published, was a later homonym of *Margarita* Gaud., it cannot, under Art. 18, Note 1 and Art. 64 of the Code, be used to give its name to a family of Myxomycetes.

Listerella is certainly out of place here and, in creating the genus, Jahn proposed that it be the sole genus of the Listerellaceae. This has merit, but the only known species is so rare and so little known that it is provisionally retained in the Dianemaceae.

KEY TO GENERA

Sporangia black, minute, dehiscent
 by preformed lobes; capillitium with angular
 thickenings, appearing moniliform; spores dusky.

Listerella

 Sporangia not black; dehiscence irregular; capillitium not annular; spores bright-colored.

b

 Capillitial threads relatively stout, nearly straight, with many of the tips attached to the peridial walls.

Dianema

 Capillitial threads slender, hair-like, coiled, with few attachments to the peridial walls.

c

c. Capillitium minutely sculptured; spores free.

Calomyxa Minakatella

c. Capillitium smooth; spores clustered.

Listerella

Jahn, Ber. Deutsch. Bot. Ges. 24: 540. 1906.

Sporangia minute, hemispherical; wall membranous, dehiscing in lobes; capillitium of slender, moniliform threads attached at base and at walls; spores black in mass, dingy by transmitted light.

Type species, Listerella paradoxa Jahn.

With a single species.

This genus is essentially a *Licea* with a capillitium. It cannot be placed in the Liceaceae as now defined, nor does it fit into the Dianemaceae. Jahn proposed for it the family Listerellaceae. That, if accepted, might be referred to the Liceales between the Liceaceae and the Reticulariaceae. G. Lister (1925) noted its resemblance to *Licea*, but placed it in the family Margaritaceae, which is essentially the equivalent of the Dianemaceae as here adopted. Pending further study, it is provisionally retained in the family.

Listerella paradoxa Jahn, Ber. Deutsch. Bot. Ges. 24: 538. 1906.

FIG. 61 Plate VI Sporangia sessile, hemispherical or pulvinate on an expanded base, 0.2–0.3 mm in diameter, dull blackish brown, marked with shining ridges along the lines of dehiscence; sporangium wall membranous, purplish brown, clothed with dark granular matter except along the lobal ridges; capillitium scanty, thread-like, flexuous, the threads 1.5–2 μ in diameter, attached at base and to walls, smooth near attachments, elsewhere marked with bead-like thickenings 1 μ in width at intervals of 2–3 μ , spores blackish in mass, pale brownish gray by transmitted light, somewhat paler on one side, faintly spinulose, 7–8 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: North Germany.

HABITAT: On Cladonia.

DISTRIBUTION: North Germany, Great Britain, Sweden, Russia; California. ILLUSTRATIONS: Ber. Deutsch. Bot. Ges. 24, pl. 22, f. 1–7; Lister, Mycet. ed.

3: 251, f. 60; pl. 191, f. d-f.

EXSICCATI: Jaap, Myx. Exs. 99; Fungi Sel. Exs. 401.

As noted, this minute species has the peridium and spores of a *Licea* but cannot be placed in that genus as now defined because of its capillitium. Jahn says that under low powers this suggests a string of pearls; G. Lister called it moniliform. Actually annulate would be closer, but it is certainly unique. Our account is based mainly on material collected by Jahn at the type locality and distributed as Jaap 401. In this material, the cupulate joints of the capillitium, mentioned in the original description and illustrated in Jahn's figures 5 and 6, have not been observed.

Calomyxa

Nieuwl., Am. Midl. Nat. 4: 335. 1916.

Margarita A. Lister, Mycet. 203. 1894. Not Margarita Gaudin, 1829.

Sporangia sessile or rarely stalked, globose, pulvinate, varying to plasmodiocarpous. Wall membranous, translucent or covered with granules. Capillitium of simple or sparsely branched, coiled or flexuous, slender, solid threads, minutely sculptured, attached at base and often to the peridium.

Type species, Physarum metallicum Berk.

With a single species.

Calomyxa metallica (Berk.) Nieuwl., Am. Midl. Nat. 4: 335. 1916.

Physarum metallicum Berk., Mag. Zool. Bot. 1: 49. 1836.

Cornuvia metallica (Berk.) Rost., Mon. App. 35. 1876.

Oligonema aeneum Karst., Bidr. Finl. Nat. Folk 4: 131. 1879.

Perichaena krupii Racib., Hedwigia 28: 124. 1889.

Perichaena plasmodiocarpa A. Blytt, Forh. Vid.-Selsk. Christiania 1892 (2): 10. 1892.

Margarita metallica (Berk.) A. Lister, Mycet. 203. 1894.

Margarita pictoviana C. L. Moore, Proc. Trans. Nova Scotia Inst. 12: 196. 1910.

Sporangia scattered or clustered, sessile, rarely with a short stalk, globose or pulvinate, 0.2–1 mm in diameter, or plasmodiocarpous, up to 10 mm long and often massed in larger groups; peridium thin, translucent, or thicker when encrusted with granular material, dull yellow, coppery or iridescent, opening irregularly above; capillitium of long, flexuous, simple or sparsely branched solid threads, marked by a row of minute tubercles running around the thread in a long spiral, with infrequent attachments to the peridial wall; spores yellow in mass, pale yellow to nearly pallid by transmitted light, delicately warted to distinctly spiny, 9–12 μ in diameter. Plasmodium watery white.

TYPE LOCALITY: England.

HABITAT: Rotten wood and bark, sometimes on bark from living trees.

DISTRIBUTION: Widely distributed in Europe and temperate North America; Jamaica; Chile; India; Japan, the Philippines.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 196; Macbr. & Mart., Myxom. pl. 16, f. 415, 416; Hattori, Myxom. Nasu pl. 14, f. 2.

This species appears fairly commonly in moist chamber cultures of bark from dead or living trees and is then often in the form of isolated sporangia or short plasmodiocarps. Field collections tend to be more densely aggregated and often more or less coalesced, sometimes approaching a pseudoaethalium. The variability of the species has resulted in the description of three varieties, none of which appears to have merit. These are:

Margarita metallica var. intermedia Meylan, Bull. Soc. Vaud. Sci. Nat. 46: 56. 1910. A specimen from Meylan appears to be a typical plasmodiocarpous fruiting of the species. It does not show the annular thickenings of the capillitium mentioned in the description.

Margarita metallica var. plasmodiocarpa (Blytt) R. E. Fries, Svensk Bot. Tidskr. 6:800. 1912. For plasmodiocarpous fruitings. These often appear in the same development with sporangiate fruitings.

Margarita metallica var. microspora Meylan, Bull. Soc. Vaud. Sci. Nat. 53: 462. 1920. With small spores, 7–8 μ .

In the second and third editions of the Lister Monograph (1911, 1925) Licea incarnata Alb. & Schw. and its derivatives in other genera are cited as possible synonyms of this species. See comments under Arcyodes incarnata (Alb. & Schw.) O. F. Cook.

Minakatella

G. Lister, Jour. Bot. 59: 92. 1921.

Sporangia sessile, densely clustered or united into a pseudoaethalium; capillitium coiled, of nearly simple, smooth, flattened threads; spores bright colored.

Type species, Minakatella longifila G. Lister.

With a single species.

FIG. 62 Plate VI Minakatella longifila G. Lister, Jour. Bot. 59: 92. 1921.

Sporangia sessile, subglobose, 0.3–0.5 mm in diameter, grouped in small, heaped clusters, the clusters sometimes stalked, sometimes united into pseudoaethalia up to 2 mm in diameter, with shining, iridescent, membranous walls; capillitium coiled, of smooth, slender, compressed, pale red threads, 1.5–2 mm in diameter, sparingly branched and with a few bulbous free ends, one side of each thread bordered by a low ridge or wing; spores in mass dull red, pale red by transmitted light, 10– $11~\mu$ in diameter, adhering in clusters of 8–14, more distinctly warted on exposed surfaces. Plasmodium unknown.

TYPE LOCALITY: Prov. Kii, Japan.

HABITAT: On bark and lichens on living tree.

DISTRIBUTION: Japan; Kentucky.

ILLUSTRATIONS: Lister, Mycet. ed. 3, pl. 208.

Lister's description and illustration give a clear picture of the species. A collection from Kentucky, Brooks 2802, is scanty, but agrees satisfactorily with the original description, except that there are distinct stalks arising as branches from the hypothallus on which two of the three fruiting clusters are borne.

Miss Lister described the capillitium as tubular. This is not apparent in her illustration, nor was it in the slide of the Kentucky specimen examined.

There seems little reason for maintaining a separate genus to accommodate this species. A slight and wholly legitimate emendation of *Calomyxa* would eliminate two monospecific genera.

Dianema

Rex, Proc. Acad. Phila. 43: 397. 1891.

Lamprodermopsis Meylan, Bull. Soc. Vaud. Sci. Nat. 46: 56. 1910.

Sporangiate, sessile or substipitate to plasmodiocarpous. Wall membranous to cartilaginous. Capillitium of smooth or obscurely sculptured, simple or forked, slender threads, attached to base and mostly to wall. Spores pallid or yellow, sometimes pinkish at first, free or united into clusters.

Type species, Dianema harveyi Rex.

There is frequent reference in the literature to the pink color of the spores, both in mass and as seen under the microscope. This is not apparent in our dried specimens, but it is not unlikely that, as in other species, of which Lycogala epidendrum is a familiar example, the pink color may be present in freshly matured fructifications.

KEY TO SPECIES

Spores free.

d

С

- a. Spores clustered.
 - Sporangia flattened-pulvinate, thin, expanded on a broad base, merging into small plasmodiocarps; capillitial threads united above and below; spores finely reticulate.

D. depressum

b. Sporangia pulvinate, sessile on a constricted base or rarely short-stipitate.

c. Wall membranous, delicate, yellowish, iridescent, sometimes thickened with brown granular accretions; capillitium profusely branched and anastomosing; coarse at base, the slender extremities attached to wall.

D. nivale

c. Wall membranous, rather firm, reddish ochraceous to dull red or brown, iridescent; capillitium sparsely branched with few anastomoses, not notably penicillate at tips when attached to wall.

D. harveyi

d. Plasmodiocarps robust; wall double, the outer layer opaque; capillitial threads 1.5–2.5 μ in diameter, without marked expansions. D. corticatum

d. Plasmodiocarps slender; wall membranous; capillitial threads 2–3 μ or more in diameter, with wide membranous expansions. D. repens

Dianema corticatum A. Lister, Mycet. 205. 1894.

Plasmodiocarps simple or branched, sometimes forming rings or close nets, less commonly shortened to pulvinate sporangia or forming a pseudoaethalium, 0.3–1 mm or more in diameter, dull purplish brown, with a more or less wrinkled surface; peridium of two layers, the outer cartilaginous, opaque, ochraceous brown, granular, the inner membranous; capillitium usually sparse, of simple or scantily branched, slender, pale brown threads, 1.5–2.5 μ in diameter, variously beaded and often spirally twisted or with the markings in long spirals; spores yellow in mass, pale or colorless by transmitted light, subglobose to broadly ellipsoidal, mostly clustered in groups of 2–6, bearing spines on the exposed side, 10–15 \times 8–10 μ . Plasmodium pink.

TYPE LOCALITY: Sande, Norway.

HABITAT: Dead wood, usually coniferous.

DISTRIBUTION: Widely distributed in Europe; in North America rare and scattered from New Hampshire to Alberta and Washington, south to Pennsylvania and California; Australia.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 193; Macbr. & Mart., Myxom. pl. 21, f. 562.

The Lister monograph says the spores are dull pink in mass. In a specimen from Miss Lister they are dull ochraceous and in our American collections they are dull to bright yellow in mass. The clustered spores appear to be held together by a very delicate, scarcely visible, gelatinous sheath.

Dianema depressum (A. Lister) A. Lister, Mycet. 204. 1894.

Cornuvia depressa A. Lister, Jour. Bot. 29: 264. 1891.

Flattened pulvinate to broadly plasmodiocarpous, 2–10 mm in the longest dimension, very thin, 0.2–0.3 mm, rarely sporangiate on a constricted base, gray-brown, glossy; peridium membranous, smooth or obscurely reticulate, translucent yellowish gray or drab, marked on the inner side with the persistent attached ends of the capillitial clusters; capillitium usually abundant, of pale yellowish gray threads, 1–2 μ thick, triangular in section, each angle bearing a row of minute tubercles, united above and below into clusters of mostly 2–6 threads, at length breaking away as an elastic web; spores mostly free, pale lilaceous gray in mass, pallid by transmitted light, the greater part of the surface covered with a delicate, rather close reticulation, 7–9 μ in diameter. Plasmodium white or rosy.

TYPE LOCALITY: England. HABITAT: Dead wood.

fig. 63 Plate VI

FIG. 64 Plate VI DISTRIBUTION: Great Britain, Sweden, Portugal; Colorado, Washington, Oregon, California; Japan; Australia.

ILLUSTRATIONS: Jour. Bot. 29, pl. 311, f. 2; Lister, Mycet. ed. 3. pl. 190; Macbr. & Martin, Myxom. pl. 16, f. 420-422.

This is the only Dianema with reticulate spores. The reticulations are delicate and can be seen only with a good lens. The species appears to be rare in North America and some of the earlier reports may be based upon erroneous determinations. The specimen illustrated is from New South Wales. The very broad, flat fructification might well be regarded as a small aethalium, but other fruitings in the same collection are, as shown, very nearly sporangiate.

Dianema harveyi Rex, Proc. Acad. Phila. 43: 397. 1891.

FIG. 65 Plate VI

Sporangia gregarious, sessile, pulvinate or plasmodiocarpous, ochraceous to dull red or brown, iridescent, 0.5-2 mm in diameter; peridium thin, membranous, translucent, rupturing irregularly; capillitium of smooth, taut, sparsely forked threads, not anastomosing nor penicillate, running from base to top; spores free, yellow in mass, pale yellowish by transmitted light, spiny, 8-10 μ in diameter. Plasmodium white.

TYPE LOCALITY: Orono, Maine.

HABITAT: Dead wood.

DISTRIBUTION: Maine, Ontario, Colorado, Great Britain; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 191, a-c; Hattori, Myxom. Nasu pl. 22, f. 4.

This species is very close to D. depressum, from which it differs in the less flattened sporangia, the spiny spores and the details of the capillitium. Although described from the United States, it appears to be very rare in North America, less so in Great Britain. Our material is not satisfactory and we are assuming that G. Lister's illustration is typical of the species.

Dianema nivale (Meylan) G. Lister, Mycet. ed. 2. 258. 1911.

Lamprodermopsis nivalis Meylan, Bull. Soc. Vaud. Sci. Nat. 46: 56. 1910. Dianema andersonii Morgan ex Macbr., N. Am. Slime-Moulds ed. 2. 239.

1922.

Sporangia sessile or short-stalked, subglobose or pulvinate, solitary or in small clusters, copper-colored, shining with iridescent green, coppery or golden reflections, 0.5-1.5 mm in diameter; sporangium wall membranous, thin, translucent; stalk, when present, short, pale, enclosing granular material; capillitium of abundant, yellowish, slender, straight or flexuous threads radiating from the thickened base, stout below, branching and anastomosing and attached by slender branchlets to the outer walls; spores at first pale grayish pink in mass, fading to yellow, yellowish and hyaline under the microscope, minutely and closely warted, 8-12 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Ste. Croix, Switzerland.

HABITAT: Turf and twigs in alpine localities.

DISTRIBUTION: Switzerland; Scotland; British Columbia.

Our extremely scanty material, one collection from Meylan, consisting of two pulvinate sporangia, one of them badly shattered, and what is left of the type collection of D. andersonii, scarcely larger, makes it extremely difficult to be certain about this species. G. Lister, Mycet. ed. 3. 254. 1925, mentions the pinkish color of the fructification and spore-mass, and that is stressed by Macbride in the original description of *D. andersonii*, but is not apparent in the two specimens mentioned. It is possible that it was more so when the specimens were first collected, since that is true of other species, *Lycogala epidendrum* e.g.

Macbride and Martin, 1934, believed the two species were distinct, but further consideration makes this doubtful. In Meylan's original descripition Lamprodermopsis is said to differ from Lamproderma only in the lack of a columella. But the very pale spores and capillitium seem to justify the transfer to Dianema by G. Lister. In a later paper, Meylan (1930) objected to this, mainly on the basis of the capillitium, without mentioning the pallid spores.

The report of this species from Washington appears to have been based on an aberrant form of Calomyxa metallica.

Pending further collections, we combine these forms in a single species.

Dianema repens G. Lister & Cran, Mycet. ed. 3: 255. 1925.

Plasmodiocarps simple or branched, 0.3 mm wide or more, dull purplish brown, surface wrinkled; wall membranous, almost colorless above, pale purplish brown below, with a thin outer layer of granular material; capillitium scanty, of brown threads, mostly 2–3 μ in diameter, broader below, branching and anastomosing and with membranous expansions at angles; spores rosy pink in mass, adhering in clusters of 4–12, globose or ovate, minutely warted on exposed surface, 10–11 μ in diameter. Plasmodium rosy red.

TYPE LOCALITY: Aberdeenshire, Scotland.

HABITAT: On lichens and hepatics on living trees.

DISTRIBUTION: Scotland, England.

According to G. Lister, this is close to D. corticatum, "differing in the slender plasmodiocarps, the membranous sporangium-wall and the coarse capillitial threads." We have seen no specimens.

Trichiaceae

Rost. Versuch 14. 1873 (as tribus).

Sporangiate, sessile or stalked, or plasmodiocarpous. Capillitium of tubular threads sculptured in characteristic fashion or nearly smooth, simple, branched or united into a net, free or attached at the base. Spores white or bright-colored in mass, hyaline, colorless, to bright yellow or red by transmitted light.

The genera here recognized are distinguished mainly by the characters of the capillitium, chiefly by the sculpturing on the threads and whether these are united into a net or are broken up into free elaters. The distinctions are not always sharp and even within a species there may be much variation in these respects. It is quite possible that some of the smaller genera will prove to be superfluous and that the limits of others may have to be altered, but the classification here adopted has proved to be, on the whole, workable, and is maintained with minor revision.

KEY TO GENERA

c.

a.	Capillitium bearing spines, cogs or rings, sometimes
	nearly smooth or more or less reticulate, or with faint,
	poorly defined spirals intermixed with other markings;
	spirals sometimes well-marked in one species of Arcyria.

b

Capillitium bearing 2-6 well-defined spiral bands, the spirals bearing spines, or smooth.

Capillitium of free elaters, these usually short, simple or sparsely branched, if long, rarely forming a complete net.

Ы

Capillitium of long, profusely branched and anastomosing threads, typically united into a net.

Perichaena

c. Elaters warted, spiny or nearly smooth or minutely annulate; sporangiate to plasmodiocarpous or, if densely clustered, not heaped; wall rather thick, usually impregnated with granular material, appearing double, rarely with excreted lime. Elaters bearing faint and irregular spirals or

Oligonema

nearly smooth; sporangia densely aggregated, usually heaped; wall thin, membranous, often iridescent. Capillitium marked as in Oligonema, but

threads united into an incomplete net.

Calonema

Capillitium variously marked, but rarely with spirals and then with basal cup and fugacious peridium

e

Peridium usually early-fugacious above the usually e. shallow, persistent, cup-like base, sometimes, in closely aggregated clusters, persisting at base, but calyculus then distinguishable; net elastic, often strongly so.

Arcyria

Peridium tending to be persistent, especially below, but not forming a morphologically distinct cup; capillitium somewhat elastic.

Capillitium bearing warts or spines; sporangia small, sessile, heaped.

Arcyodes Cornuvia

Capillitium bearing prominent coarse rings.

Peridium cartilaginous, thick, shining, opening by a preformed lid; elaters notably spiny.

Metatrichia

Peridium membranous or thickened by accretion and then dull, opening irregularly or in lobate fashion or, if by a lid, then both cup and lid membranous; elaters spiny or smooth.

h. Capillitium of thick-walled threads, the lumen

Capillitium of thick-walled threads, the lumen often obscure or lacking, arising from the base and coiled about each other in spiral bundles, the penicillate tips attached to sporangial walls.

Prototrichia

 Capillitium of thin-walled threads with evident lumen and with few or no attachments to sporangial walls.

Hemitrichia

 Threads of capillitium broken into relatively short, unbranched or sparsely branched elaters, hence free ends numerous.

Threads of capillitium united into an intricate net, with few free ends.

Trichia

i

Perichaena

i.

Fries, Symb. Gast. 11. 1817.

Pyxidium S. F. Gray, Nat. Arr. Brit. Pl. 1: 580. 1821.

Stegasma Corda, Ic. Fung. 5: 58. 1842.

Ophiotheca Currey, Quart. Jour. Micr. Sci. 2: 241. 1854.

Sporangiate to plasmodiocarpous. Peridium usually double, the outer layer granular, rarely calcareous, sometimes poorly developed; the inner membranous, closely attached. Capillitium of simple or branched tubular threads, slightly roughened to warted or spiny or, in one species, minutely annulate, but not bearing spirals. Spores yellow, minutely warted or spinulose.

Type species, Perichaena populina Fries.

Distinguished from *Trichia* mainly by the lack of spirals on the capillitium. It may be doubted whether that justifies generic rank, but the genus is generally accepted and rather readily recognized, and may be maintained for that reason.

KEY TO SPECIES

a. Spores clustered in groups of 4-16, on leaves.

P. syncarpon

a. Spores free; usually occurring on wood or bark.
b. Fructifications predominantly plasmodiocarpous.
c

b. Fructifications predominantly sporangiate.

c. Spores 10-14 μ in diameter;
 plasmodiocarps dull yellow-brown to dark
 red-brown, long, slender, curved or net-like.
 P. vermicularis

c. Spores 10 μ or less in diameter;
 plasmodiocarps often shorter and usually
 accompanied by sessile, rarely stalked, sporangia.
 d

d. Salmon-pink to ochraceous buff;
 spores 6-7 μ in diameter; capillitium
 very slender, appearing closely annulate.
 P. microspora

e. Sporangia flattened on a broad, continuous
base, usually densely aggregated and
angular from pressure; dehiscence circumscissile.

P. depressa

e. Sporangia not notably flattened, often clustered but not usually angular; dehiscence circumscissile or irregular.

е

Spores 15–17 μ in diameter;
 sporangia stalked or sessile, purplish red.

f. Spores under 15 μ in diameter; sporangia yellow to reddish brown or purplish black.

yellow to reddish brown or purplish bg. Sporangia mostly stalked; peridium bearing prominent warts; spores 9–11 μ .

P. minor

P. pulcherrima

g. Sporangia sessile; peridium not warted.

. minor

g

h. Spores 10–14 μ ; capillitium variable, up to 4 μ in diameter.

P. corticalis

h. Spores 9-10 μ ; capillitium slender, 1.5 μ in diameter.

P. tessellata

Perichaena chrysosperma (Currey) A. Lister, Mycet. 196. 1894.

Ophiotheca chrysosperma Currey, Quart. Jour. Micr. Sci. 2: 241. 1854.

Trichia curreyi Crouan, Fl. Finist. 16. 1867.

FIG. 67

Plate VII

Ophiotheca wrightii Berk. & Curt., in Berk., Jour. Linn. Soc. 10: 349. 1868. Cornuvia wrightii (Berk. & Curt.) Rost., Mon. App. 36. 1876.

Hemitrichia melanopeziza Speg., Anal. Soc. Ci. Argent. 12: 257. 1881.

Cornuvia dictyocarpa Krupa, Kosmos 11: 377. 1886.

Hemiarcyria melanopeziza (Speg.) A. Berl., in Sacc. Syll. Fung. 7: 449. 1888. Arcyria melanopeziza (Speg.) Massee, Mon. 162. 1892.

Perichaena variabilis var. pedata A. & G. Lister, Jour. Bot. 42: 139. 1904.

Perichaena pedata (A. & G. Lister) G. Lister, Jour. Bot. 75: 326. 1937.

Fructification variable, ranging from sporangiate on a restricted base or rarely short-stalked, (0.1–)0.2–0.5 mm in diameter to pulvinate or plasmodiocarpous and then flexuous, arcuate or annular to branched or forming a small network, ochraceous through reddish brown to dark chestnut-brown or nearly black; peridium double, the outer layer membranous, shining to granular, sometimes marked by reticulate ridges, rarely covered with lime, occasionally incomplete or lacking except at the base, the inner layer thin, translucent; dehiscence irregular or areolate or sometimes, in the globose fruitings, circumscissile; stalk, when present, short, thick, dark; capillitium of slender yellow threads, 2–4 μ in diameter, variable in quantity, minutely to strongly spinulose; spores yellow in mass, spinulose (7–)8–10 μ in diameter. Plasmodium white upon emergence, becoming brownish, pinkish gray or rose.

TYPE LOCALITY: England.

HABITAT: Dead wood, especially the inner bark of fallen branches; less commonly on leaves and dung of herbivorous animals.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 184; Jour. Bot. 42, pl. 459, f. 3, 4; Ber. Deuts. Bot. Gesell. 36, pl. 18, f. 14–16; Macbr. & Mart., Myxom. pl. 16, f. 426–428; pl. 17, f. 429–432; Hattori, Myxom. Nasu pl. 14, f. 5. EXSICCATI: Jaap, Myxom. Exs. 80.

Even in a single fruiting, there is often a wide variation from somewhat branched plasmodiocarps to spherical, sessile and occasionally stalked sporangia. The characteristic ring-shaped plasmodiocarps are nearly always present. Jahn (1918) describes forms with unusually long stalks which developed on dung and refers them to *P. pedata* with a suggestion that they are more closely related to *P. corticalis* than to *P. chrysosperma*.

The color in laboratory developments tends to be darker than in field collections but this is probably no more than a reflection of the fact that development under

laboratory conditions tends to continue over a period of some days, or even weeks, and the fructifications are therefore permitted to darken. In the field, drying after rain checks such continuous development and the fructifications tend to be paler in color.

In a collection from Colombia (GWM 3439), typical in other respects, the fructifications are coated with granules of lime, exactly as in some specimens of *Perichaena depressa* and *P. corticalis*.

Ophiotheca chrysosperma Currey might be regarded as a provisional name under Art. 64 of the Code. After describing the species, without naming it, the author says: "If it has not been hitherto observed, I should propose the name Ophiotheca", and later, "the colour of the spores would lead to the adoption of 'chrysosperma', or some analogous epithet."

Perichaena corticalis (Batsch) Rost., Mon. 293. 1875.

Lycoperdon corticale Batsch, Elench. Fung. 155. 1783.

Sphaerocarpus sessilis Bull., Hist. Champ. Fr. 132. 1791.

Trichia fusco-atra Sibth., Fl. Oxon. 407. 1794.

Trichia gymnosperma Pers., Obs. Myc. 1: 63. 1796.

Trichia circumscissa Schrad., Nov. Gen. Plant. 19. 1797.

Licea circumscissa (Schrad.) Pers., Syn. Fung. 196. 1801.

Physarum luteo-album Schum., Enum. Pl. Saell. 2: 199. 1803. Not P. luteo-album A. & G. Lister, 1902.

Tubulina circumscissa (Schrad.) Poir., in Lam. Encyc. 8: 131. 1808.

Perichaena abietina Fries, Symb. Gast. 11. 1817.

Perichaena populina Fries, Symb. Gast. 12. 1817.

Pyxidium sessile S. F. Gray, Nat. Arr. Brit. Pl. 1: 580. 1821.

Perichaena circumscissa (Schrad.) Schw. Trans. Am. Phil. Soc. II. 4: 258. 1832.

Perichaena marginata Schw., Trans. Am. Phil. Soc. II. 4: 258. 1832.

Perichaena fusco-atra (Sibth.) Rost., Mon. 294. 1875.

Perichaena liceoides Rost., Mon. 295. 1875.

Perichaena rostafinskii P. Karst., Bidr. Finl. Nat. Folk 31: 130. 1879.

Perichaena cano-flavescens Raunk., Bot. Tidssk. 17: 54. 1888.

Perichaena nitens Raunk., Bot. Tidssk. 17: 55. 1888.

Oligonema broomei Massee, Jour. Roy. Micr. Soc. 1889: 346. 1889.

Ophiotheca cano-flavescens (Raunk.) Massee, Mon. 134. 1892.

Ophiotheca nitens (Raunk.) Massee, Mon. 133. 1892.

Lachnobolus pygmaeus Zukal, Oesterr. Bot. Zeits. 43: 136. 1893.

Perichaena ochrospora Peck, Ann. Rep. N. Y. State Mus. 54: 156. 1901.

Sporangiate, sessile, gregarious, subglobose, hemispheric or somewhat flattened, 0.2–1 mm in diameter, varying to short-plasmodiocarpous or annulate or rarely short-stipitate, bright reddish brown to nearly black, or hoary from evaporation residue, peridium double, the outer layer often impregnated with granular material, sometimes calcareous, the inner layer membranous; dehiscence unevenly circumscissile, varying to somewhat irregular; capillitium usually scanty, of slender, branched or simple yellow threads, irregularly compressed, angled or constricted, minutely warted or spiny, rarely nearly smooth, 1.5–4 μ in diameter, attached to the sporangial wall and the lid, occasionally lacking; spores golden yellow in mass, bright yellow by transmitted light, minutely warted over all or about two-thirds of the surface. (9–)11–13(–14) μ in diameter. Plasmodium watery gray.

FIG. 68 Plate VII TYPE LOCALITY: Germany.

HABITAT: Dead wood and bark and the dung of herbivorous animals; often developing in moist chambers on bark from living trees.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Grev., Scot. Crypt. Fl. pl. 252; Lister, Mycet. ed. 3. pl. 186; Hattori, Myxom. Nasu pl. 14, f. 4.

EXSICCATI: Jaap, Myxom. Exs. 40, 60, 98, 119; Hintikka, Myxogast. Fenn. 13.

Perichaena corticalis, P. depressa and P. chrysosperma are very closely related and often difficult to distinguish. P. chrysosperma is usually scattered and frequently plasmodiocarpous, rarely with circumscissile dehiscence; the capillitium is spiny, often prominently so, and the spores are mostly $8-10~\mu$ in diameter. P. corticalis usually occurs in dense clusters on a common hypothallus, is rarely plasmodiocarpous and the sporangia are not markedly depressed nor angular from pressure, dehiscence is often circumscissile, often varying in this respect in the same cluster; the capillitium is rough but rarely with a few scattered spines, and the spores are mostly $10-14~\mu$ in diameter. P. depressa habitually occurs in dense clusters of depressed, angular sporangia with marked circumscissile dehiscence; the capillitium is minutely warted, often with prominent expansions, and the spores are $9-12~\mu$ in diameter. In all three species, some collections are coated with granular or, rarely crystalline lime. This appears to be most common in P. corticalis, somewhat less so in P. depressa, and rather uncommon in P. chrysosperma.

In their typical expression, the three species appear quite distinct, but intermediate fruitings are too common to make it certain that that is really the case.

P. chrysosperma var. liceoides (Rost.) G. Lister, Mycet. ed. 3. 247. 1925, based on P. liceoides Rost., is used for small fruitings with scanty capillitium and slightly smaller spores than those of the usual form and often occurring on dung of herbivorous animals. Such fruitings may also occur on wood, and grade imperceptibly into the fruitings with more abundant capillitium and somewhat larger spores. Lachnobolus pygmaeus Zukal and "Licea pannorum Cienk.," Jahrb. Bot. 3: 407. 1863, are cited as synonyms of the variety. The latter has frequently been cited as a synonym of P. corticalis. Cienkowski called the specimen he studied, which was clearly a Perichaena, Licea pannorum Wallr., now believed to have been applied to an ascomycete, probably Orbicula parietina (Schrad. ex Fries) Hughes. The combination attributed to Cienkowski was apparently first formally used by Massee (1892) and copied by later authors. It has no taxonomic standing.

Perichaena depressa Libert, Pl. Crypt. 378. 1837.

FIG. 69 Plate VII ?Trichia circumscissa Wallr., Fl. Crypt. Germ. 2: 378. 1833.

Stegasma depressum (Libert) Corda, Ic. Fung. 5: 58. 1842.

Perichaena artocreas Berk. & Rav., in Berk., Grevillea 2: 68. 1873.

Perichaena irregularis Berk. & Curt., in Berk., Grevillea 2: 68. 1873.

Stegasma australe Ces., Hedwigia 13: 186. 1874.

Perichaena marginata Berk. & Br., Jour. Linn. Soc. 15: 84. 1876. Not P. marginata Schw., 1832.

?Cornuvia circumscissa (Wallr.) Rost., Mon. 290. 1875.

Hemiarcyria applanata Cooke & Massee, in Cooke, Grevillea 16: 20. 1887.

Perichaena australis (Ces.) A. Berl., in Sacc., Syll. Fung. 7: 422. 1888.

Perichaena applanata (Cooke & Massee) Massee, Mon. 116. 1892.

?Ophiotheca circumscissa (Wallr.) Massee, Mon. 131. 1892.

Ophiotheca irregularis (Berk. & Curt.) Massee, Mon. 132. 1892.

Perichaena quadrata Macbr., N. Am. Slime-Moulds 184. 1899.

Sporangiate, depressed-pulvinate, crowded and polygonal by mutual contact, sometimes scattered, 0.1--1(-1.5) mm in diameter, chestnut to dark purplish brown or nearly black; peridium double, the outer wall sometimes hoary from evaporation residue or covered with amorphous or crystalline lime, closely appressed to the membranous inner layer; dehiscence circumscissile, by a definite preformed lid; capillitium of slender, simple or branched, yellow threads 2–3 μ in diameter, minutely warted or spiny or sometimes annulate, and often displaying numerous elliptic or globose expansions, usually abundant but sometimes rather scanty; spores deep yellow in mass, paler by transmitted light, minutely warted, 9–12 μ in diameter. Plasmodium colorless or yellowish.

TYPE LOCALITY: Belgium.

HABITAT: Dead bark and wood, less commonly on leaves and other plant debris and on dung of herbivorous animals.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 189; Hattori, Myxom. Nasu pl. 14, f. 6; Hagelst. Mycet. N. Am. pl. 14, f. 5.

EXSICCATI: Ellis & Ev., Fungi Colomb. 726, 1398; Jaap, Myxom. Exs. 139.

This common and widely distributed species, as here defined, is extraordinarily variable. In typical developments the most striking characters are the very flat, closely clustered, rather large, angular sporangia with markedly circumscissile lids. However, specimens similar in all characteristics except size grade down to very minute sporangia of which the extreme is represented by a specimen from Illinois, of which we have a portion, collected by H. C. Beardslee and mentioned by G. Lister (1925, p. 246). In this collection the sporangia are extremely minute, 0.05-0.15 mm in diameter and quite without capillitium. The key would take this to Licea, but the general appearance and particularly the spores and characteristic circumscissile lids make it difficult to regard it as anything but a minute extreme of the forms assigned to P. quadrata. In other collections capillitium may be sparse or apparently lacking, sometimes in mounts from individual clusters in which other mounts show abundant capillitium. The capillitium itself varies from short, free threads to long, sparsely branched threads sometimes appearing like loose nets; the markings vary from minute roughenings to short or moderately prominent spines or, as in the specimen illustrated, to minutely subannulate. Other small fruitings, when the sporangia are less closely massed, are pulvinate, with dome-shaped lids, approaching P. corticalis.

Specimens with a limy peridium are not rare and in those examined the lime is in the form of irregular crystals, not at all like those of *Didymium*. In other species the lime may be amorphous and it would not be surprising if such deposits were to be found in *P. depressa*.

In the Lister discussion mentioned above, "P. irregularis Morg." is cited. There is no such name. Morgan referred his specimens to P. irregularis Berk. & Curt. Trichia circumscissa Wallr. and its later derivatives are cited with doubt. Cornuvia circumscissa var. scabra Schroet., and var. spinosa Schroet., Krypt.-Fl. Schles. 1: 109. 1885, both varieties based on capillitial characters, suggest P. chrysosperma. Wallroth's combination was published as new; it is a later homonym of T. circumscissa Schrad., Nov. Gen. Pl. 19. 1797, here listed as a synonym of Perichaena corticalis. There may be some question as to the validity of Schrader's name, and it is unlikely that it will ever be revived.

Perichaena microspora Penz. & A. Lister, in Penzig, Myxom. Buitenz. 76. 1898.

Plasmodiocarpous, plasmodiocarps varying from short to long or reticulate, 0.25–0.35 mm in diameter, salmon pink to ochraceous buff; peridium single, yellow, membranous, smooth, thickened with granular matter at base; capillitium

FIG. 70 Plate VII netted, loose, concolorous, yellowish pink in mass, almost colorless when mounted, threads even to torulose, 1.5–2 μ in diameter, with nodular enlargements at the axils, or sometimes irregular, 1.5–5 μ in diameter, densely covered with delicate spines up to 2 μ long, the tips attached to the peridium; spores concolorous in mass, pale yellow by transmitted light, minutely spinulose, 6–7 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Buitenzorg, Java. HABITAT: Dead wood and leaves.

DISTRIBUTION: Java; Ceylon; Liberia; Florida; Louisiana.

ILLUSTRATION: Lister, Mycet. ed. 3, pl. 185.

Our best collection is from Florida, by Professor Erdman West. The well-developed plasmodiocarps are strikingly evident against the dark background of the oak leaves on which they have fruited. The Louisiana specimens, mostly on pine leaves, are small and inconspicuous. It is probable that careful search would reveal that this very distinctive species is not uncommon in the southeastern United States.

Perichaena minor (G. Lister) Hagelst., Mycologia 35: 130. 1943.

FIG. 71 Plate VII Hemitrichia minor G. Lister, Jour. Bot. 49: 62. 1911.

Hemitrichia minor var. pardina Minakata, in G. Lister, Trans. Brit. Myc. Soc. 5: 82. 1915.

Sporangia stalked or sessile, subglobose or pulvinate, 0.2–0.4 mm in diameter, scattered or in small groups, or forming plasmodiocarps, dull yellow or yellowish brown, sometimes iridescent, becoming darker with age; sporangial wall membranous, minutely papillose or bearing granular deposits and usually conspicuous, dark, rarely pale, warts; stalk, when present, black, varying from very short to two-thirds the total height; capillitium a loose, flaccid network, the threads 2–3 μ in diameter, with numerous expansions and constrictions, marked with numerous blunt spines or warts frequently so arranged as to give an impression of spiral bands, but no true spirals present; spores yellow in mass, pale yellow by transmitted light, globose, minutely warted, 9–11 μ in diameter. Plasmodium watery cinnamon.

TYPE LOCALITY: Japan.

HABITAT: Dead plant litter, bark of living trees, and dung of herbivorous animals.

DISTRIBUTION: Japan; Great Britain; New York, Ontario, Michigan, Minnesota, Iowa, Louisiana, Kansas, Texas, Saskatchewan; Panama, Philippines. ILLUSTRATIONS: Trans. Brit. Myc. Soc. 5, pl. 1, f. 3; Lister, Mycet. ed. 3. pl. 187, d-f.

In G. Lister's original description the capillitium is said to be marked by three or four faint spiral bands, which was obviously the reason for assigning it to *Hemitrichia*. There are suggestions of spirals on the elaters but when these are carefully examined such appearance seems to be due to the tendency of the spines to be arranged in spirals. The variety *pardina* was erected for forms bearing the prominent warts. Nearly all of our specimens are sporangiate and most are stalked. A collection from Kansas (Brooks 902) shows one small plasmodiocarp. The warts are a characteristic of the species and appear as deep red protrusions while the rest of the sporangium is still white. As noted in the original description, sporangia lacking the warts occur with those having them. In our developments,

such sporangia are rare and some of them, at least, are sporangia of *P. chrys-osperma*, which develop under the same conditions.

Perichaena pulcherrima Petch, Ann. Bot. Gard. Peradeniya 4: 305. 1909.

Sporangiate, either stalked and then scattered, or nearly sessile and then densely clustered, 0.5 mm in diameter, glossy purple-red or purple-brown; peridium of two closely adhering layers, the outer stout, purplish red, with scattered granular deposits, the inner hyaline, dehiscing irregularly; stalks 0.1–0.5 mm high, red-brown, furrowed, enclosing granular deposits; capillitium loose, flaccid, reddish brown, with a few rounded ends and few attachments to the peridium, marked with scattered warts and straight or curved spines 1–2 μ long, the threads 3–4 μ in diameter; spores purplish brown in mass, reddish brown under the microscope, closely spinulose, 15–17 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Ukuwela, Ceylon.

HABITAT: Dead branches.

DISTRIBUTION: Ceylon; Sierra Leone.

ILLUSTRATION: Lister, Mycet. ed. 3, pl. 188.

The capillitial threads are stout for the genus and the spores large. While other Perichaenas are said to have purplish shades, there are none which approach the color shown in Lister's figure. We have seen no specimens.

Perichaena syncarpon T. E. Brooks, Mycologia 38: 110. 1946.

Sporangia 0.05–0.8 mm in diameter, scattered, gregarious, or crowded, then sometimes forming pseudoaethalia up to 2 mm in diameter, sessile on a broad base, pulvinate to subglobose or occasionally forming short plasmodiocarps, yellowish brown or reddish brown to black, often with a black margin; sporangial wall of two layers, the outer cartilaginous, firm, opaque, thickened with dark granular deposits, the inner layer adhering closely to the outer, usually inconspicuous, membranous, pale yellow, transparent, sometimes somewhat iridescent, without granular deposits; dehiscence into lobes along preformed ridges, or irregular; capillitium scanty, occasionally lacking, attached to the sporangial wall, consisting of sparingly branched yellow threads 2–3.5 μ in diameter, marked with irregular, close-set constrictions and minute warts; spores golden yellow in mass, pale yellow by transmitted light, adhering loosely in clusters of 4–16, spinulose, more strongly so on exposed surface, globose, 10–12 μ in diameter, varying to oval or irregular. Plasmodium watery-tan to opaque tan, ochraceous, or pinkish.

TYPE LOCALITY: Geary County, Kansas.

HABITAT: Decaying leaves. DISTRIBUTION: Iowa, Kansas.

Dr. Brooks reports that this minute species is abundant in eastern Kansas. It has probably been overlooked elsewhere, as was the case with *P. microspora* until recently. The clustered spores are striking when seen in mounts and the other characters are reasonably distinctive.

FIG. 72 Plate VII Perichaena tessellata G. Lister, Jour. Bot. 69: 298. 1931.

Sporangiate, sessile; sporangia globose, scattered, purplish black, 0.1–0.5 mm in diameter, the dark outer peridium breaking up into polygonal plates and exposing the shining, translucent inner peridium; dehiscence by lobate opening or shattering of upper part, leaving a cup-like base; capillitium a network of slender, yellow threads 1.5 μ in diameter, marked with minute warts and constrictions; spores bright yellow, closely and minutely warted, 9–10 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Nasu, Japan.

навітат: Dead leaves.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATIONS: Jour. Bot. 69, pl. 598, f. 2 a-c; Hattori, Myxom. Nasu. pl. 1.

We have not seen the type collection. G. Lister's description and illustration give an excellent idea of the species and suggest that it is distinct. The threads of the capillitium are described as tubular in the original description. They are so slender that this would be difficult to determine, nor is it apparent from the illustration.

Perichaena vermicularis (Schw.) Rost., Mon. App. 34. 1876.

FIG. 73 Plate VII Physarum vermiculare Schw., Trans. Am. Phil. Soc. II. 4: 257. 1832.

Ophiotheca pallida Berk. & Curt., in Berk., Jour. Linn. Soc. 10: 350. 1868.

Ophiotheca umbrina Berk. & Curt., in Berk., Grevillea 2: 68. 1873.

Licea reticulata Berk. & Br., Jour. Linn. Soc. 14: 86. 1873.

Perichaena variabilis Rost., Mon. 295. 1875.

Perichaena friesiana Rost., Mon. 296. 1875.

Perichaena reticulata (Berk. & Br.) Rost., Mon. App. 35, 1876.

Perichaena confusa Massee, Mon. 117. 1892.

Ophiotheca reticulata (Berk. & Br.) Massee, Mon. 133. 1892.

Ophiotheca vermicularis (Schw.) Massee, Mon. 134. 1892.

Plasmodiocarpous, slender, usually 0.2–0.5 mm across, pulvinate to elongate, flexuous, sometimes reticulate or annular, varying to subglobose and sporangiate on a constricted base, dull gray or dull ochraceous to dull reddish brown or black with age; peridium thin, of two layers not always distinguishable, the outer granular, the inner membranous, papillate; capillitium usually abundant, the threads slender, 2–2.5 μ in diameter, irregular, minutely warted or spinulose; spores ochraceous yellow in mass, pale yellow by transmitted light, minutely roughened, 10–14(–16) μ in diameter. Plasmodium watery white, yellowish, or rose-red.

TYPE LOCALITY: North Carolina.

HABITAT: Dead herbaceous stems and leaves and bark.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 187, a-c; Macbr. & Mart., Myxom. pl. 16, f. 423-425.

EXSICCATI: Ellis, N. Am. Fungi 726; Jaap, Myxom. Exs. 120, 140.

As Hagelstein notes, this species appears to be commoner than its relatively infrequent collection suggests. This may be partly due to its preference for dead herbaceous stems and partly to the resemblance of the darker phases to *P. chrysosperma*. In moist chamber developments the much commoner *P. chrysosperma* is often associated with it. The chief distinctions are the generally more plasmodi-

ocarpous habit, the somewhat paler color, the nearly spineless capillitium and the larger spores of *P. vermicularis*, but in all these characters the two species overlap. In the Lister monograph, the papillose inner peridium is said to distinguish this species from all other Perichaenas but we find this character obscure, to say the least. Hagelstein (1944) reports that specimens with lime on the outer walls are occasionally found.

Ross (1967) indicated that a plasmodiocarpous fruiting which developed on bark in a moist chamber had spores averaging 12 μ in diameter, but that in those grown from this specimen on oat-dung agar in a 2-membered culture with *Escherischia coli*, the spores averaged 16 μ in diameter. He found the species to be homothallic.

EXCLUDED AND DOUBTFUL SPECIES

Ophiotheca anomala (Karst.) Massee, Mon. 135. 1892.

Cited by G. Lister, Mycet. ed. 2. 211. 1911, as possible synonym of *Trichia scabra* Rost. See comment under *Cornuvia anomala*.

"Ophiotheca circumscissa Currey," in Massee, Mon. 131. 1892.

Cited in A. Lister, Mycet. 196. 1894, as "O. circumscissa Massee," as a synonym of Perichaena chrysosperma. Massee cites Cornuvia circumscissa (Wallr.) Rost., Mon. 290. 1875, based on Trichia circumscissa Wallr., which may have been either P. depressa or P. chrysosperma.

Perichaena australis (Ces.) Berlese, in Sacc., Syll. 7: 423. 1888.

Based on Stegasma australe Ces., Hedwigia 13: 186. 1874. The brief description suggests P. chrysosperma. Although Berlese made the transfer, he lists it among the doubtful species.

Perichaena decipiens Berk. & Br., Ann. Mag. Nat. Hist. II. 17: 146. 1876.

On fir cones. Compared with *P. strobilina* Fries, of which it may be a synonym. Probably a rust.

Perichaena gregata Faut. & Lamb., Rev. Mycol. 9: 11. 1887.

Not assignable to any of the usually recognized species from description. The sporangia are said to be densely clustered, globose, conical, deep purple, appearing black to the naked eye. If a *Perichaena*, surely unique.

Perichaena microcarpa Sauter, cited by Berlese in Sacc., Syll. 7: 421.

1888, with reference to "Rabh. DC. Fl. n. 2180" (Date?), as synonym of *P. fusco-atra* (Sibth.) Rost., now regarded as synonym of *P. corticalis*.

Perichaena microcarpa Schroet., Crypt.-Fl. Schles. 3(1): 108. 1885.

Cited by G. Lister, Mycet. ed. 2. 250. 1911, as possible synonym of *P. corticalis*. If *P. microcarpa* Sauter was validly published, and if both names refer to the same thing, Schroeter's name is invalid.

Perichaena pallida (Ces.) Berlese, in Sacc., Syll. 7: 422. 1888.

Based on Stegasma pallidum Ces., Atti Accad. Sci. Napoli 8(3): 12. 1879. Listed under doubtful species in Massee, Mon. 118. 1892.

Perichaena phaeosperma Karst., Rev. Mycol. 9: 11. 1887.

The spores are described as "atrofuscae" which makes it extremely doubtful that this can be a *Perichaena*.

Perichaena picea Berk. & Br., Ann. Mag. Nat. Hist. II. 17: 140. 1876.

Not a myxomycete. Probably a pyrenomycete. See Sacc., Syll. 7: 423. 1888.

Perichaena pseudoaecidium Speg., Ann. Soc. Ci. Arg. 22: 187. 1886.

Massee, Mon. 119. 1892, said "possibly a sp. of Chondrioderma." More probably a rust.

Perichaena quercina Fries, Symb. Gast. 12. 1817.

Cited by G. Lister, Mycet. ed. 2. 250. 1911, as a possible synonym of P. corticalis, but P. chrysosperma would be equally possible.

Perichaena strobilina Fries, Symb. Gast. 2: 11. 1817.

Not a myxomycete. A rust (List., Mycet. ed. 3. 260. 1925).

Perichaena vaporaria Schw., Trans. Am. Phil. Soc. II. 4: 258. 1832.

Cited in List., Mycet. ed. 3. 246. 1925 as a possible synonym of *P. corticalis* but it could equally well be *P. chrysosperma*.

Oligonema

Rost., Mon. 291. 1875.

Fructification sporangiate, the sporangia usually densely crowded, tending to be superimposed or heaped; peridium thin, membranous; capillitium of short or long, simple or branched elaters, nearly smooth or obscurely sculptured with spirals and sometimes with spines, warts, or rings; spores yellow.

Type species, Trichia nitens Libert, 1834. Not T. nitens Pers. 1796.

While the sporangia are usually massed, they may be more or less scattered, particularly at the margins of extensive fruitings, at least in the two common species, O. flavidum and O. schweinitzii, and in both of these species the elaters may vary from very short to rather long. Too little is known of O. fulvum to generalize in this respect.

In all three editions of the Lister monograph, Oligonema is placed in the Trichiaceae and Perichaena in the Arcyriaceae and this arrangement is adopted by Schinz and Hagelstein. The two genera are scarcely generically distinct and certainly not to be referred to different families.

KEY TO SPECIES

a. Dull olivaceous; spores warted.

O. fulvum

b

- a. Dull to shining yellow; spores reticulate.
 - Peridium granular, tough; sporangia elongate,
 erect, tending to be crowded in a single layer; spores
 with a nearly complete reticulation, the bands narrow.
 O. flavidum
 - Peridium scarcely granular, delicate; sporangia irregularly globose, tending to be heaped; spores with incomplete reticulation, the bands often broad, pitted.
 O. schweinitzii

Oligonema flavidum (Peck), Peck, Ann. Rep. N. Y. State Mus. 31: 42. 1879 (as flavida).

Perichaena flavida Peck, Ann. Rep. N. Y. State Mus. 26: 76. 1874.

Oligonema brevifilum Peck, Ann. Rep. N. Y. State Mus. 31: 42. 1879 (as brevifila).

Oligonema minutulum Massee, Jour. Roy. Micr. Soc. 1889: 348. 1889 (as minutula).

Sporangia bright yellow, sessile, densely clustered, subglobose when isolated, becoming obpyriform or subcylindric when massed, 0.2–0.5 mm broad, 0.5–0.8 mm tall; peridium thin, shining or somewhat opaque, roughened or minutely papillate, with irregular fan-like markings, opening irregularly above; capillitium not usually abundant, of short to moderately long elaters, 10–300 μ long and 3–4 μ in diameter, irregular, swollen in places and occasionally branched, sculptured with minute warts arranged so as to form indistinct spirals, the apices generally blunt, sometimes ending in one or more points; spores globose, covered with a coarse-meshed, often irregular but usually complete reticulation, the bands narrow, with few pits, 13–15 μ in diameter. Plasmodium watery white, then yellow.

TYPE LOCALITY: Sandlake, New York.

HABITAT: Rotten wood in moist places; occasionally on moist soil.

DISTRIBUTION: New England to Ontario and British Columbia, south to North Carolina, Alabama, Louisiana, and California; Europe; North Africa.

FIG. 74 Plate VII illustrations: Lister, Mycet. ed. 3. pl. 165, a-c; Proc. Iowa Acad. 38: 105, f. 1–3.

There is a tendency for the sporangia to occur in a single, closely aggregated, palisade-like layer, approaching a pseudoaethalium. When the mass of sporangia rises above the substratum, as often happens, there may be a similar, but less marked, palisade layer on the lower side. The sporangia are usually larger and more cylindrical than in *O. schweinitzii* and never occur in the heaps characteristic of that species although they may be somewhat superimposed. The spore markings are also reasonably consistent, but the two species are very close to each other.

Oligonema fulvum Morgan, Jour. Cinc. Soc. Nat. Hist. 16: 36. 1893.

Perichaena annulifera Boud., Bull. Soc. Myc. Fr. 18: 144. 1902.

Sporangia olivaceous brown, sessile, clustered, subglobose on a constricted base, 0.3–1 mm in diameter, or somewhat elongated, subplasmodiocarpous; peridium membranous, olivaceous yellow, shining, marked with clear, straight lines suggesting clusters of needle-shaped crystals, and with warts; capillitium scanty, tawny, the elaters 3 μ in diameter, simple or branched, with few anastomoses, smooth or marked with a few loose, irregular spirals or occasional rings, half-rings, or barbs, occasionally swollen, the tips obscurely apiculate, 40–300 μ long, 3–5 μ wide; spores globose, yellow, closely and distinctly warted, 11–14 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Ohio.

HABITAT: Dead wood or old fungi.
DISTRIBUTION: Ohio, ?Colorado; France.

ILLUSTRATIONS: Proc. Iowa Acad. 38: 105, f. 11–14; Macbr. & Mart., Myxom. pl. 18, f. 486, 487; Bull. Soc. Myc. Fr. 18: pl. 8, f. 3; 19: pl. 4, f. B.

G. Lister, Mycet. ed. 2: 211. 1911 (repeated in ed. 3) says the type has minutely reticulate spores, and regards it as a form of T. scabra. We have a small remnant of what is certainly the type. The spores are not reticulate, but densely warted as shown in Baskerville's f. 13, in Proc. Iowa Acad. cited above. A specimen from Colorado has similar spores and capillitium, but the peridium is thicker. It may be an unusual development of the species.

Perichaena annulifera Boud. is cited as a synonym on the authority of Pavillard and Lagerheim, Bull. Soc. Myc. Fr. 19: 99. 1903. Boudier's specimen was submitted to Macbride and to Morgan, both of whom declared it was the same as Morgan's collection from Ohio. There is no "Oligonema fulvum Pav. & Lag." as cited by Lister.

Oligonema schweinitzii (Berk.) Martin, Mycologia 39: 460. 1947.

Trichia nitens Libert, Pl. Crypt. Ard. Fasc. 3. 277. 1834. Not T. nitens Pers., 1796, nor "T. nitens Fries" ex Massee, 1889.

Physarum schweinitzii Berk., Grevillea 2: 66. 1873.

Oligonema nitens (Libert) Rost., Mon. 291. 1875.

Trichia kickxii Rost., Mon. App. 40. 1876.

Trichia bavarica Thüm., Myc. Univ. 1497. 1879.

Trichia pusilla Schroet., Krypt.-Fl. Schles. 3(1): 114. 1885. Not T. pusilla Poir., 1808.

FIG. 75 Plate VII

Plate VII

FIG. 76

Oligonema bavaricum (Thüm.) Balf. & Berl., in Sacc., Syll. Fung. 7: 437. 1888.

Cornuvia nitens (Libert) Rost., in Lister, Mycet. 173. 1894.

Sporangia bright yellow, shining, sessile, irregularly globose, (0.1-)0.2-0.4(-0.5) mm in diameter, usually crowded and superimposed in dense clusters; peridium thin, translucent, nearly smooth, with faint fan-like markings; elaters usually sparse, $3-4~\mu$ in diameter, simple or branched, with faint, usually dextrorse, spiral markings, otherwise nearly smooth, sometimes with occasional rings, the tips often apiculate; spores irregularly and often incompletely reticulate, the meshes mostly large, the bands often broad and pitted, accompanied by coarse warts, $12-17~\mu$ in diameter. Plasmodium yellow.

TYPE LOCALITY: Europe.

HABITAT: Rotten wood in moist places; occasionally on moist soil.

DISTRIBUTION: Widely distributed in Europe; New England and southern Canada to Florida, Louisiana, Texas and California; North Africa.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 164, d-f; Proc. Iowa Acad. 38: 105. f. 4-7; Macbr. & Mart., Myxom. pl. 18, f. 481, 489.

EXSICCATI: Thümen, Myc. Univ. 1497; Brândză, Myxom. Roum. 112(NY).

The small, irregularly globose, heaped, shining sporangia and the bolder spore markings distinguish this species from O. flavidum. It is widely known as O. nitens—a very appropriate name—but Libert's Trichia nitens, which is the source of the epithet, is a later homonym of Trichia nitens Pers., Obs. Myc. 1: 62. 1796, which may be what is now called Trichia favoginea (Batsch) Pers. "Trichia nitens Fries" ex Massee, Jour. Roy. Micr. Soc. 1889: 333. 1889 was said by A. Lister (1894) to be a synonym of T. scabra Rost.; it seems not to have been validly published.

Calonema

Morgan, Jour. Cinc. Soc. Nat. Hist. 16: 27. 1893.

Sporangia sessile, subglobose or irregular to pulvinate, crowded, sometimes superimposed. Peridium thin, shining, dehiscing irregularly. Capillitium of branching threads arising from the base and united into a network, the surface reticulately sculptured and marked with irregular rings and spirals. Spores yellow.

Type species, Calonema aureum Morgan.

The genus is very close to *Perichaena*. The capillitium is scarcely more netted than in many specimens of *P. variabilis* and if *Oligonema* were to be merged with *Perichaena*, *Calonema* should go with it.

A single species.

FIG. 77 Plate VIII Calonema aureum Morgan, Jour. Cinc. Soc. Nat. Hist. 16: 27. 1893.

Sporangia sessile, subglobose or turbinate, 0.2–0.6 mm in diameter, or pulvinate and up to 1 mm in length, crowded, often heaped and then irregular from pressure; peridium thin, golden yellow, marked with intricate radiating veins; capillitium of branched and anastomosing threads attached to the base, free above, with obtuse or bulbous free tips, the surface reticulate-venose, very variable, portions nearly smooth, others bearing rings or fragmentary spirals,

with occasional spines; spores yellow in mass, clear, bright yellow by transmitted light, coarsely reticulate, 13–15 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Ohio. HABITAT: Decayed wood.

DISTRIBUTION: New Jersey to Minnesota, south to Florida and Louisiana. ILLUSTRATIONS: Jour. Cinc. Soc. Nat. Hist. 16: pl. 1, f. 21; Lister, Mycet. ed. 3. pl. 165, d-f; Macbr. & Mart., Myxom. pl. 20, f. 549–551.

Under a lens or dissecting microscope appearing exactly like Oligonema schweinitzii, although the spores are more like those of O. flavidum, of which G. Lister (1911, 1925) says it is scarcely more than a variety. The capillitium forms a true net, however. The capillitial markings are extraordinarily variable, even in the same sporangium showing all the variations mentioned above.

There are two specimens in the Morgan collection, one dated 1894, the year after the species was published; another, not dated, is labelled "Cornuvia elegans Morg." in Morgan's hand. We find no record of the publication of this name. Since the 1894 specimen is the better it may be regarded as the lectotype.

Arcyria

Wiggers, Prim. Fl. Holsat. 109. 1780.

Nassula Fries, Summa Veg. Scand. 456. 1849.

Arcyrella (Rost.) Racib., Rozp. Akad. Umiej. 12: 80. 1884.

Heterotrichia Massee, Mon. 139. 1892.

Sporangiate, sporangia subcylindric, ovoid or globose, stipitate or sometimes sessile by a point; peridium thin, fugacious above, typically separating by a definite line of dehiscence just above the base, the lower portion remaining as a persistent cup-like or saucer-like calyculus, in some species the margin between the persistent base and the fugacious upper part not distinct; stalks often packed with cellular vesicles resembling spores, but larger; capillitium netted, elastic, frequently expanding to more than twice the original height of the sporangium after dehiscence, either attached to both base and sides of the calyculus and tending to remain in place or merely to the center of the calyculus at the junction of the stipe and then breaking away freely, variously ornamented with half-rings, cogs, warts, spines, rings, reticulations or inconspicuous or sometimes well-developed spiral bands; spores concolorous in mass, hyaline or bright-colored under the lens.

Type species, Clathrus denudatus L.

Most of the species of Arcyria are readily recognized as belonging to the genus. Two species, A. leiocarpa and A. stipata, because of the spiral bands on the capillitium, have often been referred to Hemitrichia. However, in all but this character, they are closer to Arcyria and have been included here, as A. stipata already is in the Lister and Hagelstein treatments.

Rostafinski, Mon. 268, 274. 1875, divided the genus into two sub-genera, Clathroides ("Clatroides," corr. Mon. App. 36. 1876), characterized by firm attachment of the capillitium to the calyculus, and Arcyrella, with the capillitium loosely attached. Raciborski, 1884, used Arcyrella as a genus, without formally raising its rank. The difference, while a fairly useful key character, is neither distinct enough nor sufficiently constant to justify its use as a basis for generic segregation.

Arscyria is a variant spelling.

KEY TO SPECIES

a. Peridium fugacious except for base, which persists as a sharply defined calyculus.

a.		dium tending to persist above base, which remains deep cup, with the true calyculus often poorly defined.	s
	b.	Capillitium loosely attached to center of calyculus, readily breaking away as a whole in mature sporangia.	c
	b.	Capillitium firmly attached to	
		calyculus, basal strands not readily separating.	i
c.		ll green, fading to greenish ochraceous;	
		veulus notably small, narrow, funnel-shaped.	A. virescens
c.		ow, rosaceous or gray, sometimes	
		aceous with age; calyculus broader or wider. Yellow or buff.	d
	d. d.		e f
e.		Red or reddish, sometimes smoky olivaceous. orangia cylindrical, clear yellow, becoming bright	•
С.	och	raceous or buff; capillitium extremely elastic, the eads 3–4 μ in diameter, bearing spines, cogs and reticulations	. A. nutans
e.	Spo	orangia ovate, buff; capillitium scarcely tic, the threads 1–1.5 μ in diameter, annulate.	A. annulifera
	f.	Spores 9-11 μ in diameter; capillitium dense,	•
		slightly elastic, tending to fall away at maturity as a unit; reddish brown, fading to dull orange-brown.	A. ferruginea
	f.	Spores under 9 μ ; capillitium strongly elastic, not dense at maturity, readily breaking apart.	g
g.		ly expanded net tending to be erect;	
		ght crimson, tardily fading to brownish red.	A. incarnata
g.		ly expanded net drooping;	h
	h.	ors usually dull and dingy, rarely bright. Dull crimson to reddish brown, rarely bright rose;	11
	11.	capillitium bearing long spines; spores 7–9 μ ; fragments of peridium tending to remain attached to expanded net.	A. oerstedtii
	h.	Dingy rosaceous to smoky olivaceous,	
		capillitium bearing short spines, cogs and half-rings; spores 6–8 μ ; peridial fragments rarely persistin	g. A. magna
i.	Dul	ll green to bluish gray, becoming dingy or dark with age.	j
i.	Wit	thout greenish or bluish tints.	k
	j.	Cylindrical, clustered; cup funnel-shaped	A. glauca
	j.	Globose to short-cylindrical,	4 . 77
1.	X X 71	scattered or gregarious; cup wide, bowl-shaped.	A. nigella
k.		uite to yellow or ochraceous.	
k.	_	mon or pink to red or reddish brown.	О
	J.	Sporangia mainly cylindrical; capillitium marked by weak spirals, at least in part.	A. leiocarpa
].	Capillitium without spiral bands.	m
m.	Cu	p usually deep, bowl-shaped; sporangia globose	
		short-cylindrical; sporangia white or pale gray.	A. globosa
m.	Cu	p shallow, saucer-shaped; sporangia white to ochraceous.	n
	n.	Sporangia mostly cylindrical, but varying to ovate, white to gray or ochraceous;	
		capillitium spiny; cup smooth or stippled within.	A. cinerea
	n.	Sporangia globose to ovate or short-cylindrical, always bright ochraceous; capillitium marked with spines, cogs and	
_	c	• • •	A. pomiformis
o.	Spo	orangia ovoid to short-cylindrical, flesh-colored; cogs on capillitium blunt or hammershaped in outline.	A. carnea

- Sporangia cylindrical, usually brighter or darker in color; capillitium not bearing blunt cogs.
 p. Spores 8–10 μ in diameter.
 q. Spores mostly under 8 μ in diameter.
- q. Dull rose, 3-4 mm tall, united by stalks into clusters of 2-20; stalks one-half total height.
 q. Bright rose, 1 mm tall, not clustered; stalks very short.
 A. corymbosa
 A. minuta
 - r. Salmon to pink or bright rose; sporangia small, usually in small clusters.

 A. insignis
 - r. Bright red to brick red, fading to reddish brown; sporangia robust, often in extensive fruitings.

 A. denudata
- s. Sporangia large, bright yellow, olivaceous or brown, often touched with red; spores 9-11 μ .

 A. versicolor
- s. Sporangia of small or medium size; dull metallic, but not bright; spores 6–8 μ .
 - t. Sporangia rosy to brown or fading to ochraceous, gregarious or crowded but rarely superimposed; capillitium marked with warts and cogs, sometimes simulating spirals, but not bearing true spirals.

 A. occidentalis
 - t. Sporangia copper-colored, turning dark
 brown or fading to ochraceous; sporangia
 often heaped and united into pseudoaethalia. u
- u. Capillitium bearing at least some true spiral bands, these often faint and interspersed with spines and rings, attached at base but upper part often separating with persistent peridium.
 A. stipata
- u. Similar to A. stipata except that capillitium is marked by well-developed spiral bands only. (Hemitrichia imperialis)

Arcyria annulifera Torrend, Broteria 7: 102. 1908.

Sporangia scattered, stalked, subglobose or ovoid, 0.5–0.6 mm in diameter, buff-yellow; total height about 1 mm; calyculus membranous, papillose, rather deep, plicate below, margin regular; stalk buff, 0.2–0.4 mm tall, filled with spore-like cells; capillitium a somewhat flaccid network of slender, sparsely branched, yellowish threads, scarcely elastic, scantily attached to cup, 1–1.5 μ in diameter, marked at intervals of 1–2 μ with ring-shaped thickenings 1 μ broad; basal threads 2 μ in diameter, marked with a series of moniliform thickenings 2–3 μ long; spores pale yellow, marked with a few scattered warts, 6–7 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Pinhal d'el Rei, near Cintra, Portugal.

HABITAT: On litter under pines.

DISTRIBUTION: Known only from the type collection. ILLUSTRATION: Lister, Mycet. ed. 3, pl. 185, c,d.

As Lister notes, this is externally similar to A. pomiformis, but the capillitium is unlike that of any other Arcyria, appearing annulate under high magnifications. Torrend suggested that it might be made the type of a distinct genus, to be placed near Cornuvia. A strict adherence to key characters would probably place it in that genus, but it has less in common with C. serpula than that species has with certain other species of Arcyria and of Hemitrichia, and since Cornuvia may eventually have to be merged with one or the other a transfer would be superfluous. The scanty and molded part of the type collection in the Iowa herbarium is on decayed pine leaves. It shows clearly the well-defined cups, somewhat less pli-

FIG. 78
Plate VIII

cate than as shown in the Lister drawing and with regular margins, the slender, scanty, and non-elastic capillitium with evidence of slight attachment at the base, and the characteristic spores. The rings on the capillitium are faint even under a 2 mm objective. This could, therefore, be considered a stalked *Perichaena*. The species is apparently distinct. Pending further study, preferably on the basis of additional collections, its present provisional generic assignment should not be changed.

Arcyria carnea (G. Lister) G. Lister, Jour. Bot. 59: 92. 1921.

FIG. 79 Plate VIII Probably not A. carnea Schum., 1803; not A. carnea Wallr. 1833. Arcyria cinerea var. carnea G. Lister, in Mycet. ed. 2. 236. 1911.

Sporangia stalked, loosely clustered, ovoid or short-cylindrical, flesh-colored, 1.5–3 mm high; calyculus marked with papillae or a broken reticulation; stalks short, 0.2–0.4 mm in length; capillitium attached to calyculus, and forming a compact network of pale flesh-colored threads about 3.5 μ in diameter, for the most part marked with close-set prominences arranged in a loose spiral and appearing notched, square or hammer-headed in profile, with parts spinulose, reticulate or bearing obscure spirals, the basal threads smoother; spores 6–8 μ in diameter, nearly smooth. Plasmodium unknown.

TYPE LOCALITY: England.

HABITAT: Dead wood.

DISTRIBUTION: England, Germany, Czechoslovakia, Rumania; Japan; New York, ?Quebec, ?Pennsylvania, ?Ohio.

ILLUSTRATIONS: Jour. Bot. 59: 92, pl. 558, f. 2.

As Hagelstein (1944, p. 250) remarks, this species is not clearly marked. The description suggests close relationship with A. insignis with which it should perhaps be merged. Miss Lister's description stresses the square-ended, notched or hammer-shaped edges of the capillitial prominences as seen in profile. These are not particularly striking as shown in her figure; furthermore, a similar appearance has been observed in other Arcyrias which cannot be referred to this species. Her habit sketch shows densely clustered, short-stemmed, cylindrical sporangia which must, at the magnification indicated, be mostly 2–2.2 mm tall although in her description she gives the height as 1.5 mm. Hagelstein's No. 1582, from New York, agrees closely with Lister's illustrations and description except that the sporangia are up to 3 mm tall and the color in mass is now dull pinkish tan; a few detached sporangia are paler. This specimen has been selected for illustration. A smaller collection from Ohio, referred to this species, is bright orange-pink, more scattered and with longer stems. About all that can be said of it is that it seems to fit into A. carnea better than into any other species.

G. Lister says Arcyria carnea Schum., Enum. Pl. Saell. 2: 213. 1803, may be this species. Rostafinski, Mon. 275. 1875, cited it as a synonym of A. incarnata. He also cites A. carnea Wallr., Fl. Crypt. Germ. No. 2234. 1833 as a synonym of A. cinerea, in both cases adding in the index "p.p." In any event, Lister's name is not valid, but it would be unwise to propose a new one until further proof of the authenticity of the species is available.

Arcyria cinerea (Bull.) Pers., Syn. Fung. 184. 1801.

FIG. 80 Plate VIII Trichia cinerea Bull., Hist. Champ. Fr. 120. 1791. Not T. cinerea Trent, 1797. Stemonitis cinerea (Bull.) J. F. Gmel., Syst. Nat. 2: 1467. 1791.

Arcyria albida Pers., Neues Mag. Bot. 1: 90. 1794.

Stemonitis glauca Trent., in Roth, Catalecta Bot. 1: 221. 1797.

Stemonitis digitata Schw., Trans. Am. Phil. Soc. II. 4: 260. 1832.

Arcyria trichioides Corda, Ic. Fung. 2: 23. 1838.

Stemonitis grisea Opiz, Lotos 5: 215. 1855.

Arcyria leprieurii Mont., Ann. Sci. Nat. IV. 3: 141. 1855.

Arcyria bicolor Berk. & Curt., in Berk., Jour. Linn. Soc. 10: 239. 1868.

Arcyria pallida Berk. & Curt., in Berk., Grevillea 2: 67. 1873.

Arcyria digitata (Schw.) Rost., Mon. 274. 1875.

Arcyria stricta Rost., Mon. App. 36. 1876.

Arcyria friesii Berk. & Br., Ann. Mag. Nat. Hist. IV. 17: 140. 1876.

Comatricha alba Schulzer, Oesterr. Bot. Zeits. 27: 167. 1877.

Arcyria cookei Massee, Mon. 154. 1892.

Arcyria tenuis Schroet., in P. Henn., Hedwigia 35: 207. 1896.

Sporangia stipitate, scattered, gregarious, or united by their merged stalks into clusters of 2–20 or more, subcylindrical or ovoid, rarely broadly ovate, 0.1–0.8 mm in diameter, 0.3–4 mm tall, pale gray or drab to pallid or ochraceous; peridium fugacious except for fragments which not rarely remain attached to the expanded capillitium; calyculus concolorous, rather small, sulcate below, smooth or delicately stippled within; stalk slender, concolorous or darker, often nearly black, crowded with spore-like cells, 0.2–2 mm high, often more or less fused with other stalks in clustered developments; capillitium concolorous, firmly attached to the cup, the meshes close, the threads of the upper part (1.5–)2–4 μ in diameter, densely covered with blunt spinules, occasionally also with cogs, bands or reticulations; those below larger, 2–6(–10) μ in diameter, smooth to spinulose; spores pale gray or yellowish in mass, colorless by transmitted light, with a few scattered, inconspicuous warts, 6–7 μ in diameter. Plasmodium white, less commonly gray or yellowish.

TYPE LOCALITY: France.

HABITAT: Dead wood, plant debris or the dung of herbivorous animals.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATION: Bull., Herb. Fr. pl. 477, f. 3; Rost., Mon. pl. 10, f. 182–185,
193; Lister, Mycet. ed. 3. pl. 176, a-e; Hattori, Myxom. Nasu pl. 2, f. 5;
Mycologia 54: 518, f. 11–18.

EXSICCATI: Ellis, N. Am. Fungi 1115; Jaap, Myxom. Exs. 78, 118; Brândză, Myxom. Roum. 87(NY); Thaxter, Rel. Farl. 374.

An extremely common, widely distributed and variable species. While usually on wood, where it frequently forms extensive and prominent colonies, it may fruit on leaves, where it is apt to be smaller and more scattered. On bark, in moist chambers, a small brownish ochraceous form often develops which seems to merge with the gray forms in some cultures; in others, the two may appear simultaneously but remain distinct. The digitate form, to which Schweinitz applied the epithet digitata, often occurs in large fruitings in which all the sporangia are digitate. In other collections, however, all gradations occur between scattered and digitate sporangia and there is complete gradation between various collections in this character. The small ochraceous fruitings approach A. pomiformis. Farr (1963) discusses the two species, emphasizing the differences in the markings of the calyculus and the capillitium as reliable taxonomic criteria.

Lachnobolus arcyrella Rost., Mon. 431. 1925, is cited by G. Lister, Mycet. ed. 3. 232. 1925, as a doubtful synonym of A. cinerea. Berlese, in Sacc., Syll. Fung. 7: 434. 1888, recognized the species. His Latin description would apply very well to the brown, ovate forms mentioned above. If they should be found to be worthy of recognition as distinct from A. cinerea, Rostafinski's specific epithet, when combined with Arcyria would not be a tautonym.

Arcyria corymbosa Farr & Martin, Broteria ser. Cienc. Nat. 27: 154. 1958.

FIG. 81 Plate VIII

Sporangia stalked, subcylindrical, tapering slightly toward the apex, dull rose to light cinnamon brown, united in clusters of 2-20 by the individual but fused stalks, total height after expansion 3-4 mm, the individual sporangia 0.3-0.5 mm in diameter; hypothallus broadly expanded, continuous, membranous, hyaline, shining; stalks about half the total height, slender, longitudinally plicate, reddish brown, frequently surrounded by a membranous sheath extending from the hypothallus, merging into the conical, iridescent, membranous cup, filled throughout with round to oval cells which are pale brown by transmitted light; capillitium firmly attached to base of calyculus, forming a dense, elastic net, very pale reddish brown by transmitted light, of irregular tubes nearly even to strongly crenulate in outline, marked with scattered, single or loosely grouped, blunt papillae or cogs and occasional obscure spirals, otherwise smooth, 2-7 μ in diameter, with free ends short and acute inside the cup, rounded or irregular above; spores ferruginous in mass, pale reddish yellow by transmitted light, globose or subglobose, marked with scattered or loosely grouped prominent warts and very faint lines suggesting an incomplete reticulum, (8-)9-10(-11) μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Recife, Brazil. HABITAT: Bark of decaying log.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATION: Broteria 27: 155, f. 1.

The clustered sporangia suggest those of the digitate phases of Arcyria cinerea, from which A. corymbosa differs, not only in color, but in the quite larger, more strongly marked spores and unique capillitium.

FIG. 82 Plate VIII Arcyria denudata (L.) Wettst., Verh. Zool.-Bot. Ges. Wien 35: Abh. 535. 1886. Clathrus denudatus L., Sp. Pl. 1179. 1753.

Mucor clathroides Scop., Fl. Carn. ed. 2. 2: 493. 1772.

Mucor pyriformis Leers, Fl. Herborn. 288. 1775. Not M. pyriformis Scop. 1772.

Arcyria clathroides (Scop.) Wiggers, Prim. Fl. Holsat. 109. 1780.

Embolus crocatus Batsch, Elench. Fung. Contin. 1: 365. 1786.

Stemonitis crocatus (Batsch) Willd., Fl. Berol. 408. 1787.

Stemonitis coccinea Roth, Fl. Germ. 1: 548. 1788.

Trichia denudata (L.) Vill., Hist. Pl. Dauph. 3: 1060. 1789.

Trichia graniformis Hoffm., Veg. Crypt. 2: 3. 1790.

Trichia cinnabaris Bull., Hist. Champ. Fr. 121. 1791.

Stemonitis crocea J. F. Gmel., Syst. Nat. 2: 1467. 1791.

Trichia rufa With., Brit. Pl. ed. 2. 3: 478. 1792.

Arcyria punicea Pers., Neues Mag. Bot. 1: 90. 1794.

Arcyria conjugata Schum., Enum. Pl. Saell. 2: 215. 1803.

Stemonitis denudata (L.) Relhan, Fl. Cantabr. ed. 3. 574. 1820.

Arcyria vernicosa Rost., Mon. App. 36. 1876.

Sporangia crowded or gregarious, stalked, ovoid or short-cylindric, tapering upward, (1.5–) 2–6 (–7) mm tall, 0.4–1.2 mm wide when expanded, pompeian red to brick-red, weathering to brown; peridium evanescent except for the plicate calyculus; stalk dark or concolorous, striate, ascending from a small hypothallus, 0.5–1.5 mm long; capillitium elastic, usually erect, bright

red or carmine, fading to brown or dull yellowish, the threads 3–4 μ in diameter, marked with a series of rather distant cogs or half-rings arranged spirally around the axis, attached to the whole inner surface of the calyculus, hence not deciduous; spores red or reddish brown in mass, colorless by transmitted light, with a few scattered warts, 6–8 μ in diameter. Plasmodium white.

TYPE LOCALITY: Italy. HABITAT: Dead wood.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 174; Nat. Geogr. Mag. 49(4): pl. 15; Hattori, Myxom. Nasu pl. 2, f. 1.

EXSICCATI: Ellis, N. Am. Fungi 1114; Brândză, Myxom. Roum. 30(NY).

This very common species is usually easy to recognize, especially when freshly matured. The relatively large size of the sporangia, the often extensive fruitings in which they occur, and the deep rose color are distinctive. The color is rather fugitive, becoming, with age, dingy ochraceous to nearly fuscous. Such color change is particularly apparent in the field, but may occur in the herbarium, some collections fading much more rapidly than others. The species is most likely to be confused with the somewhat less common A. incarnata, which is a brighter red and tends to retain its color better. The strongly attached capillitium, rather long stalks and usually narrow cups of A. denudata contrast with the loosely attached capillitium, shorter stalks and typically wide, shallow cups of A. incarnata. Hagelstein (1944, p. 254) speaks of "frequent intermediate forms." It is true that the characters mentioned do overlap to some extent, but in general the collections are readily assigned to one or another of the two species. Most of our collections of A. denudata are on angiosperm wood, while those of A. incarnata appear to occur more frequently on coniferous wood, but this is so inconstant as to be of slight significance.

The Lister monograph lists Arcyria minor Schw., Trans. Am. Phil. Soc. II. 4: 259. 1832, as a doubtful synonym of A. incarnata. Schweinitz does say "affinis A. incarnata", but the description applies better to a small form of A. denudata and Morgan applied Schweinitz's name to such collections.

Arcyria ferruginea Sauter, Flora 24: 316. 1841. Not A. ferruginea Fckl. 1870.

Arcyria dictyonema Rost., Mon. 279. 1875.

Arcyria intricata Rost., Mon. App. 37. 1876.

Arcyria cinnamomea Hazsl., Oesterr. Bot. Zeits. 27: 84. 1877.

Arcyria bonariensis Speg., Ann. Soc. Ci. Arg. 10: 151. 1880.

Arcyria macrospora Peck, Ann. Rep. N. Y. State Mus. 34: 43. 1883.

Arcyrella inermis Racib., Rozp. Akad. Umiej. 12: 82. 1884.

Arcyrella decipiens Racib., Rozp. Akad, Umiej. 12: 84. 1884.

Arcyria aurantiaca Raunk., Bot. Tidssk. 17: 61. 1888.

Arcyria raciborskii Berl., in Sacc., Syll. Fung. 7: 430. 1888 (as raciborsckii).

Heterotrichia gabriellae Massee, Mon. 140. 1892.

Arcyria clavata Čelak. f., Arch. Nat. Land. Böhmen 7(5): 29. 1893.

Arcyria nodulosa Macbr., N. Am. Slime-Moulds ed. 2. 252. 1922.

Arcyria ornata Widder, Verh. Zool.-Bot. Ges. Wien 73: 160. 1923.

Sporangia stipitate, crowded or gregarious, ovoid or short-cylindric before expansion, 1–2 mm tall, 0.5–1 mm in diameter, expanding only slightly, dull orange to brick-red or reddish brown; capillitium very sparsely attached at the center, falling away readily, concolorous, fading, the coarse threads forming a rather open net which tends to fall away as a whole, the threads 5–8(–10) μ in

FIG. 83 Plate VIII diameter above, more slender below, marked by transverse bars, warts, and reticulations; calyculus large, wide, shallow, nearly smooth or reticulate within; hypothallus membranous, continuous, yellowish brown; spores reddish in mass, pale ochraceous by transmitted light, minutely warted, 9–12 μ in diameter. Plasmodium rose-red or cream.

TYPE LOCALITY: Austria. HABITAT: On dead wood.

DISTRIBUTION: Europe; in North America from Nova Scotia to Washington, south to South Carolina, Texas, and California; West Pakistan; Ceylon; South Africa; New Zealand.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 173; Macbr. & Mart., Myxom. pl. 18, f. 464, 465.

EXSICCATI: Brândză, Myxom. Roum. 114(NY); 68(IA); Thaxter, Rel. Farl. 375.

The coarse, open, readily detached net, the threads marked by warts and irregular bands often arranged to form a somewhat reticulate pattern, the wide, shallow, nearly smooth calyculus and the spores, large and rather strongly marked for an *Arcyria*, make this species fairly easy to recognize in its typical expression.

The following varieties were all published by Torrend, Broteria 6(2): 98. 1909: var. helvetica Torrend, var. heterotrichia (Massee) Torrend and var. cornuvioides (Racib.) Torrend (based on Arcyrella cornuvioides Racib., Hedwigia 28: 123. 1889). The Lister monograph recognizes the var. heterotrichia and cites the var. gabriellae Grove, Proc. Birm. N. S. Phil. Soc., 12: 20. 1910, both based on Heterotrichia gabriellae Massee. None of these varieties is satisfactorily defined, and the small spores of Arcyrella cornuvioides, described by Raciborski as mostly 7 μ , suggest A. incarnata rather than A. ferruginea. Krzemieniewska recognizes it as distinct as Arcyria cornuvioides (Racib.) Krzem., Sluz. Polsk. 264. 1960.

Judging by our collections, A ferruginea is not particularly common in eastern North America, but the dull color and rather ready separation of the net from the calyculus might lead collectors to pass it over as an old and weathered form of A. incarnata.

Arcyria glauca A. Lister, in Minakata, Bot. Mag. Tokyo 22: 322. 1908.

FIG. 84 Plate VIII

Sporangia stalked, clustered, ovoid to cylindrical, 0.4–2.5(–5) mm tall and 0.4–0.8(–1) mm broad when expanded, pale bluish green, fading to greenish drab; calyculus funnel-shaped, membranous, somewhat fluted, faintly reticulate; stalk pale green or grayish brown, curved and weak, 0.2–0.3 mm long, filled with spore-like cells; capillitium an elastic network of pale threads, 2.5–3 μ in diameter, with many attachments to the cup and a few rounded free ends, marked with a loose spiral of prominent, narrow cog-like plates, or in part nearly smooth or with scattered spinules and an irregular reticulation, or with three or four faint spiral lines; spores pale glaucous in mass, nearly smooth, 7 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Itoda, Japan. HABITAT: On dead wood.

DISTRIBUTION: Japan; Tahiti; New South Wales. ILLUSTRATIONS: Lister, Mycet. ed. 3, pl. 182.

The original habitat has been destroyed, but it is to be hoped that collectors will be on the watch for this striking species, which is not to be confused with occasional greenish fruitings of A. cinerea. Lister's beautiful illustration shows very short stalks and rather uniform capillitial markings except for a basal portion

attached to the calyculus. We have two collections from New South Wales and one from Tahiti which appear to fit the description.

The only other Arcyrias with greenish tints at times are A. nigella, which is small and globose, A. virescens, which has long, firm stalks and is much yellower as a rule, and the greenish phase of A. versicolor, which has a deep, lobed cup and much larger spores.

Arcyria globosa Schw., Schr. Nat. Ges. Leipzig 1: 64. 1822. Not Arcyria globosa Weinm., 1829.

Craterium globosum (Schw.) Fries, Syst. Myc. 3: 154. 1829.

Nassula globosa (Schw.) Fries, Summa Veg. Scand. 456. 1849.

Lachnobolus globosus (Schw.) Rost., Mon. 283. 1875.

Arcyria albida var. globosa (Schw.) A. Lister, Mycet. 186. 1894.

Sporangia globose, stipitate, scattered or gregarious, 0.3–0.7 mm in diameter, 0.5–1.5 mm tall, white, pale ashy gray or rarely pale yellowish; peridium thin, concolorous, the upper half fugacious, leaving the lower half as a deep, goblet-shaped calyculus; stalk 0.2–0.8 mm tall, concolorous or somewhat darker, hollow, filled with spore-like cells; capillitium pallid, scarcely elastic, close-meshed, the threads 3.5–4.5 μ in diameter, marked with warts and sometimes indistinct reticulations and nodular swellings up to 10 μ in width; spores colorless, very minutely spinulose, with a few scattered warts, 7–8.5 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: North Carolina.

HABITAT: Usually on dead chestnut burs; rarely on dead leaves or catkins. DISTRIBUTION: Eastern United States; Washington; Colombia; central Europe; Portugal; Ceylon; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 176, g-i; Macbr. & Mart., Myxom. pl. 18, f. 466, 467; Hattori, Myxom. Nasu pl. 2, f. 6.

EXSICCATI: Ellis, N. Am. Fungi 116, 1214; Thaxter, Rel. Farl. 401.

With the nearly complete destruction of the American chestnut, this species, formerly common, has become very rare in the eastern United States. It is often confused with globose fruitings of A. cinerea and, when occurring on substrata other than the old chestnut burs formerly its usual habitat, it is likely to be referred to that species. It may be distinguished, not only by the globose shape, but by the deep calyculus and the scarcely elastic capillitium, which led Rostafinski to refer it to Lachnobolus.

Arcyria incarnata (Pers.) Pers., Obs. Myc. 1: 58. 1796.

Stemonitis incarnata Pers., in J. F. Gmel. Syst. Nat. 2: 1467. 1791.

Trichia flexuosa Schum., Enum. Pl. Saell. 2: 209. 1803.

Arcyria lilacina Schum., Enum. Pl. Saell. 2: 212. 1803.

Arcyria adnata Rost., Mon. App. 36. 1876.

Arcyrella irregularis Racib., Rozp. Akad. Umiej. 12: 83. 1884.

Arcyrella incarnata (Pers.) Racib., Hedwigia 24: 170. 1885.

Sporangia crowded, cylindric, stalked or nearly sessile, 1–2 mm tall. 0.5–0.8 mm broad before expansion, becoming greatly expanded, often reaching 5 mm in total height, rosaceous to crimson, weathering to brown; peridium evanescent except for the shallow, saucer-like, inwardly roughened, usually plicate calyculus; stalk usually short, sometimes merely a point, occasionally up to 0.6 mm in

FIG. 85 Plate VIII

FIG. 86
Plate VIII

length, concolorous or darker, filled with spore-like cells, arising from a dull red, inconspicuous, but often continuous hypothallus; capillitium loose, very elastic, expanding to twice the original height of the fructification or more, consisting of a network of rosy threads 3–5 μ in diameter, marked with transverse plates, cogs, and half-rings arranged in an open spiral, attached to the calyculus at the center only and breaking away freely; spores rosy in mass, colorless by transmitted light, marked with a few scattered warts, 7–8 μ in diameter. Plasmodium white.

TYPE LOCALITY: Germany.

HABITAT: Dead wood.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 177; Hattori, Myxom. Nasu pl. 2, f. 2.

EXSICCATI: Brândză, Myxom. Roum. 89(NY); 69, 106, 170(IA); Jaap, Myxom. Exs. 39; Hintikka, Myxogast. Fenn. 1.

Distinguished from A. denudata by the brighter and less fugitive color, by the usually shorter stem and wider cup, and especially by the very loosely attached capillitium.

The variety fulgens G. Lister, Mycet. ed. 2. 242. 1911, has been applied to forms with crimson sporangia and firm, dark, reddish brown stalks. We have specimens so labeled which do not seem sufficiently distinct from the other forms to deserve a special name. Arcyria adnata Rost. is cited by Massee (1892) and generally by later authors. Rostafinski's name is based on Clathrus adnatus Batsch, Elench. Fung. 141. 1789, the identity of which is uncertain.

Arcyria assamica Agnihothrudu, Jour. Ind. Bot. Soc. 37: 501. 1958, is very close to A. incarnata, from which it is distinguished by the rather long, dark stalks, the slender capillitium, 2–3 μ , and the small spores, said to be 3.5–6 μ in diameter. We have seen only some shattered fragments, but find the capillitium as described and the spores 5–6 μ . The species is known only from the type locality, but the description suggests that it may be sufficiently distinct from A. incarnata to deserve recognition.

Arcyria insignis Kalchbr. & Cooke, in Kalchbr., Grevillea 10: 143. 1882.

FIG. 87
Plate IX

Sporangia gregarious or clustered or occasionally solitary, stipitate, bright rose to flesh colored or pale salmon, occasionally fading to yellowish, ovate or cylindric, 0.5–1.5 (–3) mm tall; stalk rather short, 0.2–0.4 mm in height, reddish, filled with spore-like cells; cup somewhat plaited, nearly smooth or faintly netted within; capillitium a close network of delicate threads 2–3 μ in diameter, sometimes with a few bulbous free ends and marked with transverse bands and spines arranged in a loose spiral, in part minutely spinulose to nearly smooth, attached to the calyculus; spores pinkish in mass, colorless under the lens, with a few scattered and inconspicuous warts, 6–8 μ in diameter. Plasmodium watery-white.

TYPE LOCALITY: South Africa.

HABITAT: Dead wood and herbaceous stems.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATION: Lister, Mycet. ed. 3. pl. 181.

EXSICCATI: Thaxter, Rel. Farl. 376.

A rather difficult species to define, but usually distinctive, recognizable in the field by the small compact clusters of bright pink sporangia. The color is usually quite different from that of freshly matured A. denudata. Under the lens, the capil-

litial threads are slender, branching and anastomosing to form a close-meshed net which remains attached to the cup.

The variety major G. Lister, Mycet. ed. 3: 236. 1925, was erected for somewhat robust collections and the variety dispersa Hagelstein, Mycologia 21: 298. 1929, was applied to fruitings in which the sporangia are scattered rather than in the characteristic clusters. The former may be distinct; the latter merges imperceptibly with the typical form and seems unworthy of recognition.

Arcyria leiocarpa (Cooke) Martin & Alexop. comb. nov.

Hemiarcyria leiocarpa Cooke, Ann. Lyc. N. Y. 11: 405. 1877.

Lachnobolus rostafinskii Racib., Rozp. Akad. Umiej. 12: 80. 1884.

Hemitrichia leiocarpa (Cooke) A. Lister, Mycet. 177. 1894.

Sporangia stalked, usually cylindrical, but varying to ovate or subglobose, 0.4–0.7 mm in diameter and up to 1.5 mm tall, pale gray or ochraceous; sporangial wall fugacious above, persistent at the base as a fluted, shallow calyculus; stalk slender, cylindric, 0.5–1 mm tall, concolorous or somewhat darker, filled with spore-like cysts; capillitium a loose net of branching and anastomosing, tubular, concolorous threads, firmly attached, rather weakly elastic, 3–5 μ in diameter, bearing 3–5 sinistrorse, usually fairly prominent but sometimes faint spirals, smooth or spiny or in part replaced by spines; spores gray or ochraceous in mass, nearly colorless by transmitted light, faintly and sparsely warted, 7–9 μ in diameter. Plasmodium colorless, turning white before fruiting.

TYPE LOCALITY: Maine.

HABITAT: Dead wood, mosses, leaves, and dung of herbivorous animals.

DISTRIBUTION: Maine, Pennsylvania, Florida, Ontario, Louisiana, Texas, Oregon; Panama; Colombia; Scotland (in green house); Czechoslovakia. ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 168, a, b (globose form).

The widely scattered distribution may mean that the species is very rare, or, what is more probable, that it has been confused with other species, particularly Arcyria cinerea, from which it cannot be distinguished except by examination of its capillitium. G. Lister (1925) notes that the spiral bands are arranged in the reverse way from most of the species of Trichia and Hemitrichia. She refers to the spirals as "dextral"; we should call them sinistrorse (see p. 146). We have not seen claters like those shown in her figure 168 b, but her drawing is convincing. In the text, she speaks of the sporangia looking like slender forms of A. cinerea, but in her Fig. 168 a, the sporangia are nearly globose. Sometimes the loose spirals look spiny, particularly on the outside of curves, but careful examination will show that these are not spines, although, as noted in the description, spines may replace the spirals in part.

In every character except that of the spiral bands on the elaters, this is a typical *Arcyria*. It should be referred to that genus with the generic diagnosis modified to include it. Cultural studies, when they become possible, may show that it should be included in *A. cinerea*, perhaps as a variety.

In Cooke's Myxomycetes of Great Britain, 88. 1877, Hemiarcyria leiocarpa is listed, without author citation, as illustrated by figures 252 and 255, both showing only the spiral structure of the elaters, but the species was not mentioned in the text. It was formally described in his Myxomycetes of the United States, published later in the same year and the earlier figures were cited in the description.

Arcyria magna Rex, Proc. Acad. Phila. 45: 364. 1893.

Sporangia densely aggregated, stipitate, the clusters often several centimeters in extent, smoky olivaceous gray to dark cinereous or occasionally dull

FIG. 89

Plate IX

FIG. 88 Plate IX rose, cylindric, 1.5–2 mm tall, 0.6–0.8 mm in diameter, attaining a length of 5–15 mm or more when fully expanded, then lax and drooping, the long nets falling away in tangled clumps; calyculus small, translucent, shining, funnel-shaped; stalk 0.1–1 mm tall, filled with spore-like cells, sometimes branched; capillitium concolorous, nearly free and quickly breaking away, extremely elastic, the threads 3–4 μ in diameter, coarsely sculptured with half-rings, cogs, and spines; hypothallus membranous, continuous; spores concolorous in mass, colorless under the lens, minutely papillate, 6–8 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Philadelphia, Pennsylvania.

HABITAT: Dead wood.

DISTRIBUTION: New York to Oregon, south to Florida and Texas; Panama; Philippines. Not common.

ILLUSTRATIONS: Macbr. & Mart., Myxom. pl. 17, f. 446-449.

A. Lister, in the first edition of the Mycetozoa (1894), insisted that A. magna was to be included in A. oerstedtii and this disposition was followed by G. Lister in the later editions. Macbride (1899, 1922), Macbride and Martin (1934), Hagelstein (1944), and Martin (1949) maintained it as distinct. Certainly, the two species have much in common, but the larger size of the sporangia, the deep cups, the smoky color, the cogged capillitium, and the smaller spores as compared with the shorter sporangia, the shallow cups, the ferruginous tints, the tendency of plate-like fragments of the peridium to adhere to the expanded capillitium, the spiny capillitium, and the larger spores of specimens referred to A. oerstedtii seem to be reasonably constant. For the present, it seems justifiable to maintain the two as distinct.

The var. rosea Rex, Proc. Phila. Acad. 45: 365. 1893, is described as bright rose-red when fresh, fading somewhat with age. It may be worthy of recognition as a true variety and not a response to some environmental condition.

A. magna is perhaps less uncommon in North America than A. oerstedtii, but appears to have been unknown elsewhere prior to a recent collection from the Philippines (Reynolds 886).

Arcyria minuta Buchet, in Pat., Mem. Acad. Malgache 6: 42. 1927.

Sporangia bright rose, cylindrical, scattered or in small clusters, 1 mm tall; stalk very short, 0.1 mm or less, furrowed, transparent, filled with spore-like cells; cup thin, furrowed, delicately papillate or reticulate within; capillitium firmly attached, forming a network with few or no free ends, the threads pale, 1.5–2 μ in width, ornamented by uniformly distributed spines without evidence of spiral arrangement; spores nearly smooth, rose-vermilion in mass, 8–10 μ in diameter.

TYPE LOCALITY: Maromandia, Madagascar.

HABITAT: Fallen branch.

DISTRIBUTION: Known only from the type collection.

Differing from A. insignis in its capillitial markings, from A. cinerea in its color and very short stem, and from both in its larger spores. No rosy phases of A. cinerea are known and its stalk is usually at least one-third and often one-half or more of the total height.

Arcyria nigella Emoto, Bot. Mag. Tokyo 42: 201. 1928.

Sporangia scattered or gregarious, broadly ovate to short-cylindrical, 0.5–0.7 mm in diameter, 1–1.5 mm tall, grayish white to bluish white or dull green,

the older sporangia sometimes becoming dingy ochraceous or dull gray; calyculus wide, bowl-shaped, strongly netted within; stalk short, one fifth to one-third the total height, dark, filled with spore-like cells; capillitium scanty, scarcely elastic, 4–6 μ broad, with swellings to 8 μ or more, marked with spines and reticulations; spores concolorous or darker in mass, minutely roughened, 7–9 μ in diameter. Plasmodium probably grayish white.

TYPE LOCALITY: Tokyo, Japan.

HABITAT: Dead wood and bark of living trees.

DISTRIBUTION: Japan; Michigan, Iowa.

ILLUSTRATIONS: Bot. Mag. Tokyo 42: 202. f. 1-3.

The above description is based on the original description and illustrations supplemented by examination of specimens which developed in moist chambers on bark collected from living elm in Michigan and from living ash in Iowa. The former was accompanied by A. cinerea, of which it was at first believed to be an aberrant phase. The olivaceous color, the somewhat larger and rougher spores, the strongly netted cup and the different type of capillitium rule this out, however. Emoto suggests relationship with A. ferruginea and A. cinerea. The relationship seems to us closer to A. pomiformis, but it seems to be quite distinct from all of these.

Arcyria nutans (Bull.) Grev., Fl. Edin. 455. 1824.

Trichia nutans Bull., Hist. Champ. Fr. 122. 1791.

Stemonitis nutans (Bull.) J. F. Gmel., Syst. Nat. 2: 1467. 1791.

Arcyria flava Pers., Neues Mag. Bot. 1: 90. 1794.

Stemonitis amoena Trent., in Roth, Catalecta Bot. 1: 222. 1797.

Trichia elongata Schum., Enum. Pl. Saell. 2: 209. 1803.

Arcyria alutacea Schum., Enum. Pl. Saell. 2: 212. 1803.

Arcyrella nutans (Bull.) Racib., Hedwigia 24: 170. 1885.

Sporangia crowded, cylindric, 1.5–2 mm tall, 0.3–0.5 mm broad, expanding to a length of 4–12 mm and then lax and drooping, at first bright yellow, but soon changing to pale ochraceous or buff, short-stipitate or sessile by an acute base on an extensive membranous hypothallus; peridium fugacious, leaving a shallow, translucent yellowish calyculus, spinulose-reticulate within; capillitium concolorous, extremely elastic, scarcely attached at the base, the threads 3–4 μ in diameter, marked with spines, half-rings, and irregular reticulations; spores buff or ochraceous in mass, nearly colorless by transmitted light, with a few indistinct, scattered warts, 7–8 μ in diameter. Plasmodium watery-white.

TYPE LOCALITY: France. HABITAT: Dead wood.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Bull., Herb. Fr. pl. 502, f. 3; Lister, Mycet. ed. 3. pl. 179;

Hattori, Myxom. Nasu pl. 2, f. 3.

EXSICCATI: Ellis & Ev., N. Am. Fungi 1214; Hintikka, Myxogast. Fenn. 2;

Brândză, Myxom. Roum. 71 (IA).

This rather common and widely distributed species is usually easy to recognize at sight by the pale, rather dull yellow, drooping, large sporangia with nets which are readily detached from the cups. Occasional small fruitings or those which are darker in color merge into the usual form and give little trouble.

FIG. 90 Plate IX Arcyria occidentalis (Macbr.) G. Lister, Mycet. ed. 2. 245. 1911.

FIG. 91 Plate IX Lachnobolus occidentalis Macbr., N. Am. Slime-Moulds 188. 1899.

Sporangia ovate to subcylindric, short-stipitate or sessile on a constricted base, at first rosy, then brown or ochraceous, closely gregarious or crowded, sometimes approaching a pseudoaethalium, often distorted by pressure but rarely heaped; peridium thin, metallic, persistent or somewhat fugacious above, the sides persisting as lobes; calyculus scarcely differentiated, irregular, more or less ribbed or fluted; stalk, when present, up to 1.5 mm long, concolorous or darker, hollow, filled with spore-like cells; capillitium a loose, readily detached net, scarcely to moderately elastic, sometimes scanty, with many free ends and inflations, the threads mostly 3–4 μ wide, marked with warts and low transverse cogs often simulating spirals; spores very minutely spinulose, with scattered larger warts, 7–8 μ in diameter. Plasmodium white, then rosy.

TYPE LOCALITY: Iowa. HABITAT: Dead wood.

DISTRIBUTION: Maine to Manitoba and Washington, south to Alabama, Nebraska, and California; ?Brazil; West Pakistan; Japan.

ILLUSTRATIONS: Macbr., N. A. Slime-Moulds, pl. 2, f. 2; Lister, Mycet. ed. 3.
 pl. 192; Macbr. & Mart., Myxom. pl. 18, f. 476, 477; Hattori, Myxom.
 Nasu pl. 2, f. 4.

This moderately common species is quite variable. The color varies from rather dark to fairly pale, apparently correlated in part with the time that has elapsed between maturation and collection. The calyculus is faintly distinguishable, but the margin between it and the rather persistent peridium is not always sharp, and the characteristic deeply lobed cup is composed in part of the peridium. In some specimens, the net is moderately elastic, in others scarcely so or not at all, which accounts for its assignment to *Lachnobolus*, and it may be rather scanty. In closely appressed developments the stalks tend to be reduced to a point and in old collections the cups are more pronounced. However, the same collection may show all phases with complete intergradation.

The species was at first referred by Macbride, Bull. Nat. Hist. Univ. Iowa 2: 126. 1899, to "Lachnobolus incarnatus Alb. & Schw." It is clear from the context that this was a reference to Lachnobolus incarnatus (Alb. & Schw.) Schroet., here listed under Arcyodes, and was a misidentification. This does not constitute valid publication of L. incarnatus (Alb. & Schw.) Macbr., although the name was listed as such in synonymy by Macbride himself in 1899, and by later authors.

Arcyria oerstedtii Rost., Mon. 278. 1875.

fig. 92 *Plate* IX Hemiarcyria fuliginea Cooke & Massee, in Cooke, Grevillea 16: 74. 1888. Arcyria fuliginea (Cooke & Massee) Massee, Mon. 169. 1892.

Sporangia crowded on an extensive hypothallus, stipitate, cylindric, 1.5–2 mm tall, becoming arcuate, 4–10 mm tall when expanded, dull crimson to reddish brown, rarely bright rose; peridium evanescent except for a few small plates which may remain attached to the capillitium; cup obconical, rather shallow, plicate, papillose within; stalk short, weak, concolorous, filled with spore-like cells; capillitium a loose, very elastic net, scarcely attached, the threads concolorous, irregular, mostly 3–5 μ in diameter, but often with numerous bulbous enlargements, marked with close-set, conspicuous spines, some reaching 3 μ in length; spores concolorous in mass, pale yellowish by transmitted light, minutely spinulose, 7–9 μ in diameter. Plasmodium watery white, then rosy.

TYPE LOCALITY: Denmark. HABITAT: Rotten wood.

DISTRIBUTION: Europe; Maine to Washington, south to Louisiana and southern California; scattered, uncommon; southern Asia; Japan; South Africa; Australia.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 180.

EXSICCATI: Brândză, Myxom. Roum. III 2: 32; 82(NY); 67(IA).

As noted under A. magna, the Listers included that species in A. oerstedtii. As a result, some of the reports of A. oerstedtii probably refer to specimens of A. magna if that species is regarded as distinct.

A specimen from northern California, Kowalski, 2383, is brilliant rose in color and has rather long stalks, but otherwise is typical.

Arcyria pomiformis (Leers) Rost., Mon. 271. 1875.

Mucor pomiformis Leers, Fl. Herborn. 284. 1775.

Stemonitis pomiformis (Leers) Roth, Fl. Germ. 548. 1788.

Stemonitis ochroleuca Trent., in Roth, Catalecta Bot. 1: 221. 1797.

Stemonitis lutea Trent., in Roth, Catalecta Bot. 1: 221. 1797.

Arcyria silacea Ditmar, in Sturm. Deuts. Fl. Pilze 1: 15. 1813.

Arcyria lutea (Trent.) Schw., Schr. Nat. Ges. Leipzig 1: 63. 1822.

Arcyria ochroleuca (Trent.) Fries, Syst. Myc. 3: 181. 1829.

Arcyria globosa Weinm., in Fries, Syst. Myc. 3: 181. 1829, as syn. Not A. globosa Schw., 1822.

Arcyria winteri Wettst., Oesterr. Bot. Zeits. 35: 199. 1885.

Sporangia scattered or gregarious, globose or broadly ovate, rarely broadly cylindrical or somewhat constricted in center, 0.3–0.7 mm in diameter, 0.5–1 mm tall, becoming 0.8–2 mm tall when expanded, bright ochraceous; calyculus shallow, sulcate, bearing coarse papillae, often irregular and united into a reticulate pattern; stalk one-third to one-half the total height, ochraceous to pale brown, filled wih spore-like cells; capillitium concolorous, attached, rather open, expanding laterally and longitudinally, the threads 3–5(–8) μ in diameter, often with swellings, marked with cogs, transverse bands and spines sometimes connected by ridges, with numerous, often clavate, free ends often present; spores yellow in mass, faintly ochraceous by transmitted light, with a few scattered warts, (7-)8-9(-10) μ in diameter. Plasmodium white.

TYPE LOCALITY: Germany.

HABITAT: Dead wood, sometimes bark of living trees.

DISTRIBUTION: Throughout Europe and North America; South America; West Pakistan; Japan; South Africa.

ILLUSTRATIONS: Macbr. & Mart., Myxom. pl. 18, f. 468–470; Hattori, Myxom. Nasu pl. 21. f. 5; Mycologia **54**: 518, f. 1–10.

EXSICCATI: Ellis & Ev., N. Am. Fungi 3497; Jaap, Myxom. Exs. 20; Brândză, Myxom. Roum. 84(NY); Thaxter, Rel. Farl. 378.

The var. heterospora G. Lister, Jour. Bot. 71: 221. 1933, based on a collection from Japan, is said to differ from the typical form in its somewhat larger spores, 8–10 μ in diameter, the presence of spiral bands at the base of the capillitial threads, where they are attached, and the very short stalk. These characters, together with the rather casual reference to the unusual variation in spore size, all suggest that this is a developmental variant, not deserving a varietal name.

FIG. 93 Plate IX Farr (1962) discusses this species and the closely related A. cinerea. A pomiformis is never gray or whitish, it is in general smaller, although the smallest specimens of A. cinerea are much smaller than the smallest specimens of A. pomiformis, the shape is usually globose or very broadly ovate as compared with the usually more slender sporangia of A. cinerea. Brown and ovate specimens of A. cinerea must be distinguished by the characters of the calyculus and the capillitium. The spores of A. pomiformis tend to be somewhat larger than those of A. cinerea.

Arcyria stipata (Schw.) A. Lister, Mycet. 189. 1894.

FIG. 94 Plate IX Leangium stipatum Schw., Trans. Am. Phil. Soc. II. 4: 258. 1832.

Hemiarcyria stipata (Schw.) Rost., Mon. App. 41. 1876.

Hemitrichia stipata (Schw.) Macbr., N. Am. Slime-Moulds 204. 1899.

Sporangia crowded, stalked, 1.5–3 mm tall, erect, or more or less superimposed, then nearly or quite sessile and often united by the persistent peridia, forming a pseudoaethalium, in fresh collections copper-colored or reddish, metallic, often with lavender or rose tints, changing to deep ochraceous or brown with age; hypothallus dark brown, common to a cluster; stalk 0.1–1.5 mm tall, dark brown, hollow, the interior filled with spore-like cysts; peridium, where not fused with that of neighboring sporangia, evanescent above, leaving a shallow calyculus, persistent when fused, eventually splitting into lobes which tend to remain attached to the calyculus; capillitium concolorous, attached at base, somewhat elastic, forming a loose net, with bulbous thickenings and numerous free ends, the upper part often breaking away with the peridium, the threads 3–5 μ wide, bearing 3–4 spirals, these more or less intermixed with spines, cogs, half-rings or occasional rings and reticulations; spores pallid, globose, minutely roughened, sometimes with occasional larger warts, 6–8 μ in diameter. Plasmodium yellow, becoming white, then rosy as fruiting occurs.

TYPE LOCALITY: Pennsylvania.

HABITAT: Dead wood.

DISTRIBUTION: Throughout North America; Europe; Asia; Sierra Leone; Oceanica.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 178; Macbr. & Mart., Myxom. pl. 20, f. 527-529.

As noted in the synonymy, this species has been classified with *Hemitrichia* on the basis of the spiral bands on the capillitium but has been placed in *Arcyria* in all editions of the Lister monograph and by Hagelstein. The spirals are sometimes very marked and with few of the variations noted above, but in many collections they are not prominent and the other markings are more prominent. Hagelstein (1944, p. 254) seems to imply that spirals are never present, but with that conclusion we cannot agree. The over-all picture is that of a somewhat aberrant *Arcyria*, perhaps rather closely related to *A. occidentalis*, as Hagelstein suggested.

The plasmodium is deep yellow. Before fruiting, it disappears into the substratum and emerges pure white, becoming deep rose as it proceeds to fruit.

Arcyria versicolor Phill., Grevillea 5: 115. 1877.

Arcyria vitellina Phill., Grevillea 5: 115. 1877.

Sporangia crowded, stalked to nearly sessile, obpyriform, the total height 2-3.5 mm before dehiscence, 1-2 mm broad, expanding to 5-6 mm; peridium shining, clear yellow to olivaceous, scarlet, dull reddish or olivaceous brown,

FIG. 95

Plate IX

dehiscent near the apex, the bulk of the membrane persisting as a deep, lobed, cup-like base, often not sharply distinguished from the peridium; stalk strand-like, weak, filled with spore-like cells, usually rather short, sometimes a mere point, arising from a prominent, venulose hypothallus; capillitium strongly elastic, concolorous, scarcely attached, the threads 5–6 μ in diameter, spinulose or spiny-reticulate, rarely with faint bars; spores yellow to olivaceous brown or dull reddish brown in mass, pale ochraceous by transmitted light, minutely spiny, 9–11 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: California.

HABITAT: Dead coniferous wood.

DISTRIBUTION: Plowa, South Dakota, Wyoming, Colorado, Nevada, Idaho,

Washington, Oregon, California; southeastern Europe; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3, pl. 175.

This is mainly a mountain species. The origin of the single collection recorded from Iowa may be incorrect. The color is not quite so variable as the description suggests, ranging in most collections from clear yellow, through chrome to olivaceous. A collection from Mt. Shasta (W. B. Cooke 10192) shows many bright scarlet peridial fragments; others show duller red remnants. This suggests that the plasmodium may be red. The deep cup, the large spores and the coarse threads of the capillitium are all distinctive.

In some specimens, of which the one illustrated (Mt. Shasta, W. B. Cooke 18062) is an example, the capillitium, at full expansion, is sharply divided into two portions, a lower portion with a close net and an upper portion with a loose net. In this specimen, the lower portion is distinctly rosy and the upper portion ochraceous brown.

Arcyria virescens G. Lister, Jour. Bot. 59: 252. 1921.

Sporangia crowded or clustered, often forming large colonies, stalked, cylindrical, greenish, fading to greenish ochraceous; calyculus small, narrow, funnel-shaped, reticulate and spinose within; stalks slender, dark olive-green, 0.5–1.5 mm high, with few or no spore-like cells inside, free or adherent in groups of two to ten; capillitium a loose elastic network of greenish or yellowish threads, free from the cup and expanding into a column about 6 mm long and 1 mm wide, the threads 5–6 μ in diameter, marked with scattered groups of close-set, prominent, sharp-edged transverse ridges 3–5 μ high, arranged in an open spiral, the remaining surface obscurely reticulate and roughened with delicate spines; spores yellowish green in mass, 7–9 μ in diameter, nearly smooth. Plasmodium white.

TYPE LOCALITY: Ceylon. HABITAT: Dead wood.

DISTRIBUTION: Ceylon; Malaya; Queensland. ILLUSTRATION: Lister, Mycet. ed. 3, pl. 222.

The dull green color of the sporangia, the narrow cups tipping dark stalks without spore-like cells within and the markings on the capillitial threads are the characteristics of this species. It has been reported from Iowa and Oregon in the United States but reexamination of specimens on which such reports are based suggests that they should be referred to other species. Reports of its occurrence in Hawaii, Japan, China and Madagascar may be better founded.

EXCLUDED AND DOUBTFUL SPECIES

FIG. 96 Plate IX

[&]quot;Arcyrella affinis Rost." ex Krzem., Sluz. Pol. 263. 1960.

Cited in synonymy. Not validly published. Rostafinski did include the species in his subgenus Arcyrella.

Arcyrella decipiens Racib., Rozp. Akad. Umiej. 12: 82. 1884.

Cited by Krzemieniewska, Sluz. Pol. 258. 1980, as synonym of A. ferruginea.

Arcyrella similis Racib., Rozp. Akad. Umiej. 12: 81. 1884.

Cited as synonym of Arcyria affinis Rost., q.v., by Krzemieniewska, Sluz. Pol. 263, 1960.

Arcyria affinis Rost., Mon. 276. 1875.

Cited as doubtful synonym of *A. incarnata* var. *fulgens* by G. Lister, Mycet. ed. 2. 242. 1911 and in ed. 3. 238. 1925. Regarded as distinct by Krzemieniewska, Sluz. Pol. 263. 1960.

Arcyria calyculata Massee, Mon. 162. 1892.

Probably a Hemitrichia close to H. stipitata.

Arcyria carletae Hertel, Dusenia 5: 120, 1954.

Description suggests a brown form such as is here included in A cinerea. If these forms should be regarded as distinct, this name should be considered.

Arcyria carnea Wallr., Fl. Crypt. Germ. 2: 383. 1833.

Not a myxomycete. A Stilbella? See G. Lister, Mycet. ed. 3. 259. 1925.

Arcyria cinerea Fries, Syst. Myc. 3: 180. 1829.

Not A. cinerea (Bull.) Pers. according to Berkeley and Broome, who applied the name A. friesii to it. Fries cites Trichia cinerea Bull. and Arcyria albida Pers., both of which are now regarded as referring to A. cinerea (Bull.) Pers. On p. 179, Fries cites A. cinerea Pers. Syn. Fung. 179. 1801, as a synonym of A. fusca Fries, quoting Albertini & Schweinitz as authority. A. cinerea Fries is clearly a later homonym of A. cinerea (Bull.) Pers., applied to what is now regarded as the same species.

Arcyria cinerea (Schum.) Hornem., Fl. Dan. 11(33): 13 pl. 1975, f. 1. 1829, "vix Pers." refers to Fries "n.4" which is A. cinerea in the modern sense. He cites Schumacher "1, c. p. 19", n.v.

Arcyria cylindrica Schum., Enum. Pl. Saell. 2: 215. 1803. ?A. denudata G. Lister, Mycet. ed. 3. 235. 1925.

Arcyria decipiens Berk., Ann. Mag. Nat. Hist. I. 9: 447. 1842. Not Persoon, 1795. Placed by G. Lister, Mycet. ed. 3. 221. 1925, in her *Hemitrichia clavata* complex. Since it came from Brazil, it is probably *H. stipitata*.

"Arcyria decipiens Racib." ex G. Lister, Mon. ed. 2. 234. 1911.

Not validly published. See Arcyrella decipiens.

Arcyria dentata Schum., Enum. Pl. Saell. 3: 213. 1803.

Doubtful synonym of A. denudata according to G. Lister, Mycet. ed. 2. 240. 1911.

"Arcyria elongata Bong., Herb.," ex Berlese, in Sacc., Syll. 7: 439. 1888.

Cited in synonymy. Probably not validly published. *Arcyria flexuosa* Rab., Deuts. Krypt.-Fl. 1: 258. 1844.

Doubtful synonym of A. oerstedtii, according to G. Lister, Mycet. ed. 3. 240. 1925.

Arcyria fonsecae Hertel, Dusenia 5: 119. 1954 (as fonsecai).

Appears to agree with A. ferruginea in color, shape and spore size, but differs in capillitium.

Arcyria fusca Fries, Symb. Gast. 17. 1818.

Cited by Lister, Mycet. ed. 2. 240. 1911, as doubtful synonym of A. denudata. But see Fries, Syst. Myc. 3: 179. 1829, and Killerman, Ber. Deut. Bot. Ges. 54: 556, pl. 37a. 1936.

Arcyria glomerata Fries, Summa Veg. Scand. 457. 1849.

Without description but with citation of *Trichia circumscissa* Wallr. Evidently intended as change of name. Cited in Lister, Mycet. ed. 2. 248. 1911, as possible synonym of *Perichaena chrysosperma*.

Arcyria grisea Opiz, Lotos 4: 215. 1855.

Cited by Berlese in Sacc., Syll. Fung. 7: 427, as synonym of A. cinerea.

Arcyria lateritia de By., Mycet. 21. 1864.

Not formally and probably not validly described. Cited by Rost., Mon. 279. 1875, as synonym of A. ferruginea; "p.p." in index.

Arcyria leocarpoides (Speg.) Massee, Mon. 167. 1892.

Based on Cornuvia leocarpoides Speg. Probably Hemitrichia stipitata.

Arcyria melanocephala Schum., Enum. Pl. Saell. 2: 213. 1803.

Possible synonym of A. denudata. G. Lister, Mycet. ed. 2. 240. 1911.

Arcyria olivacea Rausch, 1797.

So cited by Berlese, in Sacc., Syll. 7: 442. 1888. Ref. not located; possibly not validly published.

Arcyria pusilla (Speg.) Massee, Mon. 168. 1892.

Based on Hemitrichia pusilla Speg., q.v.

Arcyria pyriformis Wiggers, Prim. Fl. Holsat. 109. 1780.

Wiggers says "cf. Hall. n. 2168." Haller's figure suggests *Trichia varia* and Wiggers' brief description might apply to this.

Arcyria ramulosa (Rudolphi) Wigand, Jahrb. Wiss. Bot. 3: 43. 1863.

Based on Trichia ramulosa Rudolphi, q.v.

Arcyria rufa Wiggers, Prim. Fl. Holsat. 109. 1780.

Wiggers cites Haller, "n. 2163, T. 48, f. 4." Probably an Arcyria but otherwise unidentifiable.

Arcyria rufa (Dicks.) Schum., Enum. Pl. Saell. 2: 214. 1803.

A later homonym of A. rufa Wiggers. Based on Lycoperdon rufum Dicks., Pl. Crypt. Brit. 1: 35. 1785. Cited in G. Lister, Mycet. ed. 2. 240. 1911, as possible synonym of A. denudata.

"Arcyria similis Racib.," ex G. Lister, Mon. ed. 2. 242. 1911.

Not validly published. See Arcyrella similis.

Arcyria stelfeldii Hertel, Dusenia 5: 122. 1954.

Possibly a dark phase of A. nutans.

Arcyria straminea Wallr., Fl. Crypt. Germ. 2: 383. 1833.

According to Berlese, in Sacc., Syll. 7: 429, 1888, a synonym of A. nutans. G. Lister, Mycet. ed. 2. 236. 1911, listed it as a doubtful synonym of A. cinerea.

Arcyria trichia Wiggers, Prim. Fl. Holsat. 109. 1780.

Not identifiable.

Arcyria trichioides Rudolphi, Linnaea 5: 120. 1855.

Cited by Berlese, Sacc., Syll. 7: 447, 1888, as a synonym of Hemiarcyria clavata.

Arcyria umbrina Schum., Enum. Pl. Saell. 2: 213. 1803.

A possible synonym of A. pomiformis, G. Lister, Mycet. ed. 2. 238. 1911.

Arcyria vermicularis Schum., Enum. Pl. Saell. 2: 212. 1803.

Arcyria punicea var. vermicularis (Schum.) Fries, Syst. Myc. 3: 178. 1829, was based on this. G. Lister, Mycet. ed. 2. 245. 1911, cited both the species and the variety as possible synonyms of A. oerstedtii.

Arcvodes

O. F. Cook, Science 15: 651. 1902.

Lachnobolus Fries, Summa Veg. Scand. 457. 1849. Not Lachnobolus Fries, 1825.

Sporangia distinct, clustered, sessile or short stalked, often heaped; wall single, membranous, persistent, at least below, as a deep, irregularly lobed cup; capillitium a loose, irregular, inelastic network, the threads spiny, warty or somewhat reticulate, arising from the base and attached at numerous points to the sporangial wall; spores pallid.

Type species, Licea incarnata Alb. & Schw.

Lachnobolus Fries, Syst. Orb. Veg. 148. 1825, must have as its type L. cribrosus Fries, now universally recognized as the basionym of Amaurochaete cribrosa (Fries) Macbride. In Syst. Myc. 3: 177. 1828, Fries reduced L. cribrosus to probable synonymy with Reticularia atra (Alb. & Schw.) Fries. In the same

work, Fries recognized Perichaena congesta (Sommerf.) Fries (p. 192), based on Physarum congestum Sommerf., and citing as a synonym Lycoperdon pineum Batsch, Elench. Fung. 155. 1783, the description of which suggests a Lycogala. Perichaena incarnata (Alb. & Schw.) Fries (p. 193) is recognized as a separate species. Lachnobolus is not recognized as a genus, but the name is used in a different sense for a subdivision ("tribus") of Arcyria, embracing the single species A. circinans Fries, apparently first published in Stirp. Femsj. 83. 1826 (not seen). In Fl. Scan. 356. 1835, Fries made passing reference to Lachnobolus as a genus intermediate between Arcyria and Trichia, and formally published it as such in Summa Veg. Scand. 457. 1849, making the type Lachnobolus circinans. Obviously, Lachnobolus Fries 1849, is a later homonym of Lachnobolus Fries 1825, and is invalid. Since the generic name Lachnobolus has been "used in different senses and so has been a long-persistent source of error," it should be rejected under Art. 69. See paper by O. F. Cook, Science 15: 650-651. 1902, in which Cook decided that the only way out of the confusion was to rename the genus. His suggestion was ignored in the various monographs which appeared in the following years until Martin accepted the genus in 1949 (N. A. Fl. 1(1): 42).

The type of the genus must be Licea incarnata Alb. & Schw. It must be admitted that neither the description nor the illustration of that species is completely convincing, but neither are the descriptions of Physarum congestum and the various applications of its specific epithet in other combinations used by the earlier writers. Miss Lister's suggestion (Mycet. ed. 3: 252. 1925) that Licea incarnata Alb. & Schw. may have referred to Margarita metallica, i.e. Calomyxa metallica of the present treatment, seems highly improbable.

With a single species.

Arcyodes incarnata (Alb. & Schw.) O. F. Cook, Science 15: 651, 1902.

Licea incarnata Alb. & Schw., Consp. Fung. 109. 1805.

Lycogala incarnatum (Alb. & Schw.) Sw., Handl. K. Svenska Vet. Acad. III. 3: 112. 1815.

Physarum congestum Sommerf., Suppl. Fl. Lapp. 241. 1826.

Arcyria circinans Fries, Stirp. Fems. 83. 1826.

Perichaena congesta (Sommerf.) Fries, Syst. Myc. 3: 192. 1829.

Perichaena incarnata (Alb. & Schw.) Fries, Syst. Myc. 3: 193. 1829.

Licea congesta (Sommerf.) Wallr., Fl. Crypt. Germ. 2: 345. 1833.

Lachnobolus circinans (Fries) Fries, Summa Veg. Scand. 457. 1849.

Lachnobolus sauteri Rost., in Fuckel, Jarhb. Nass. Ver. Nat. 27–28: 76. 1873. Arcyria congesta (Sommerf.) Berk. & Br., Ann. Mag. Nat. Hist. IV. 17: 140.

Lachnobolus incarnatus (Alb. & Schw.) Schroet., Krypt.-Fl. Schles. 3(1): 110. 1885.

Arcyria hariotii Massee, Mon. 155. 1892.

Lachnobolus congestus (Sommerf.) G. Lister, Mycet. ed. 2. 246. 1911.

Sporangia subglobose, sessile or with a short stalk, crowded and heaped, rarely somewhat scattered, 0.4–0.8 mm in diameter, pale copper-colored, fading to dull ochraceous; hypothallus inconspicuous, scanty, common to a cluster; peridium membranous, somewhat opalescent, persistent, irregularly dehiscent above, marked with minute warts and ridges; capillitium a non-elastic network of branched and anastomosing threads, mostly 3–4 μ in diameter, with numerous inflations, closely marked with warts and spines, ochraceous in mass, pallid by transmitted light, attached to sporangial wall; spores subglobose or angled by mutual pressure, pale pink or ochraceous in mass, pallid by transmitted light,

FIG. 97 Plate IX smooth save for a few scattered warts, 6–8 μ in diameter. Plasmodium white or rosy.

TYPE LOCALITY: Germany. HABITAT: Dead wood.

DISTRIBUTION: Massachusetts, New York, Ontario, Colorado, Iowa, Nevada and Oregon in North America; widely distributed in Europe but not common.

ILLUSTRATIONS: Alb. & Schw., Consp. Fung. pl. 10, f. 6; Lister, Mycet. ed. 3. pl. 183; Macbr. & Mart., Myxom. pl. 17, f. 443-445.

We have in the Iowa collection two specimens of this species from Oregon and one each from Massachusetts, Iowa and Nevada, in addition to an example sent by A. Lister to Macbride many years ago and presumably from England. The report of its collection in New York, Ontario and Colorado is based on Hagelstein. Many of our specimens from North America originally referred to the species were incorrectly determined. Most of them are Arcyria occidentalis, which, because of its relatively inelastic capillitium, was formerly included in Lachnobolus. The capillitium is quite different.

The species is apparently rare in North America and not much commoner in Europe, but it is easily overlooked despite its moderately large size and may be more common than the collections indicate.

Cornuvia

Rost., Versuch 15. 1873.

Sporangiate or plasmodiocarpous, sessile; capillitium not elastic, consisting of a network of flaccid threads bearing coarse rings and with free ends; spores reticulate.

Type species, Arcyria serpula Wigand.

This genus shows affinity with both *Hemitrichia* and *Arcyria*. One species of *Arcyria*, *A. annulifera*, has a capillitium bearing rings, in that case minute. *Cornuvia* might well be returned to *Arcyria* since some species of *Arcyria* have a scarcely elastic capillitium, or, if it is to be maintained, perhaps the generic diagnosis should be so expanded as to include *A. annulifera*.

With a single species.

Cornuvia serpula (Wigand) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27-28: 76. 1873.

Arcyria serpula Wigand, Jahrb. Wiss. Bot. 3: 44. 1863. Not A. serpula (Scop.) Massee, 1892.

Ophiotheca serpula (Wigand) Massee, Mon. 135. 1892.

Varying from sessile, subglobose sporangia to small branched or netted plasmodiocarps, shining golden yellow; sporangium wall membranous, delicate, smooth, pale yellow; capillitium a flaccid, loose network of yellow threads 3–5 μ in diameter, marked with well-defined ring-like thickenings clustered at intervals or irregularly scattered, smooth between the rings and at junctions, with occasional or numerous free ends; spores yellow, coarsely reticulate with narrow bands forming 8–12 meshes to the hemisphere, 10–12 μ in diameter. Plasmodium creamy white.

FIG. 98 Plate X TYPE LOCALITY: Germany.

HABITAT: Bark, especially tan-bark.

DISTRIBUTION: England, Germany, Denmark; east Africa; Michigan; India. ILLUSTRATIONS: Jahrb. Wiss. Bot. 3, pl. 3, f. 18; Lister, Mycet. ed. 3, pl. 170, d, e.

Arcyria ochroleuca (Trent.) Fries, here cited as a synonym of A. pomiformis, following Lister, was said by Wigand to have a capillitium marked with complete rings, as illustrated in Jahrb. Wiss. Bot. 3, pl. 3, f. 16. 1863. Wigand's question mark, p. 43, indicates that he was doubtful whether the form he studied was Fries's species. The brief description on p. 41 makes it clear that his material was not Cornuvia serpula; it may have been a form of A. pomiformis with aberrant capillitium.

EXCLUDED AND DOUBTFUL SPECIES

Cornuvia anomala (Karst.) Karst., Bidr. Finl. Nat. Folk 31: 131. 1879.

Based on *Trichia anomala* Karst., Nat. Saellsk. Fl. Fenn. 9: 354. 1868. A. Lister, Mycet. 182. 1894, suggested it might be an irregular form of *Trichia scabra* and it was doubtfully referred to that species in the later editions of the Lister monograph. A small portion of the type, sent by Karsten to Wingate was formerly in the Iowa collection but has unfortunately been misplaced, although we have a slide made from it. Massee, Mon. 135. 1892, transferred it to *Ophiotheca*, citing both of Karsten's names. Both the description and the slide of the type make it impossible that this should be *T. scabra*. Wingate's reference of it to *Lachnobolus circinans* Fries, i.e. *Arcyodes incarnata* of the present treatment, may be correct.

Cornuvia leocarpoides Speg., Ann. Soc. Ci. Arg. 12: 256. 1881.

Cited by G. Lister, Mon. ed. 2. 226, as synonym of *Hemitrichia clavata*. The description suggests that this may be *H. stipitata*.

Metatrichia

Ing, Trans. Brit. Mycol. Soc. 47: 51. 1964.

Sporangiate, sessile or stalked, often united into clusters or large aggregates forming pseudoaethalia, the walls thick, cartilaginous, tough, rough without, smooth and shining within, each sporangium dehiscent by a preformed operculum; elaters free, unbranched, bearing prominent, strongly developed spines. Capillitium and spores deep orange-red to crimson in mass.

Type, Metatrichia horrida Ing.

The original diagnosis says the peridium is double, the outer layer cartilaginous, the inner membranous. In both the type species, of which we have seen the paratype, and in the extremely common M. vesparium, the inner part of the peridium is smooth and the outer part suggests an incrustation, but is also shining. The two parts are so closely united that the double nature of the wall is not apparent except in occasional mounts examined under the microscope.

In both species there is a tendency for the elaters to be bent back in the middle, with the two halves coiled about each other, but that character, the reddish color and the spiny capillitium occur also in species of *Trichia* and *Hemitrichia*. There is a preformed lid in *Trichia crateriformis*, and there is a tendency for the elaters to be bent with the halves curled about each other, but both cup and lid in that species are membranous.

KEY TO SPECIES

a. Sporangia sessile, dark purplish red, shining, with metallic reflections; operculum sunken within a raised rim; spines on elaters 2–4 μ.

M. horrida

a. Sporangia stalked, rarely sessile, deep maroon, nearly black to reddish brown or steel gray, shining, with metallic reflections; operculum dome-shaped, without sunken rim; spines on elaters rarely over 2 μ.

M. vesparium

Metatrichia horrida B. Ing, Trans. Brit. Mycol. Soc. 47: 51. 1964.

Sporangia sessile, subcylindrical, densely crowded, angular from pressure, firmly united into pseudoaethalia composed of usually 200 or more sporangial units, each 0.4–0.9 mm in height and 0.4–0.5 mm in diameter, seated on an extensive reddish orange hypothallus, dark purplish red; peridium opaque, firm, shining, with metallic reflections; dehiscence by a preformed flattened pulvinate lid, sunken within a raised marginal rim; capillitium of very long free elaters, not rarely recurved with the two halves coiling about each other, 5–6 μ in diameter, the tips bluntly shortened and usually terminating in a short spine, ornamented with three or four spiral bands bearing conspicuous spines 2–4 μ long, deep orange-red in mass; spores orange-red in mass, reddish ochraceous by transmitted light, nearly smooth or with a few minute spines, 9.5–11 μ in diameter. Plasmodium probably red or reddish.

TYPE LOCALITY: Panshanu Forest Reserve, Nigeria.

HABITAT: Decayed wood.

DISTRIBUTION: Known only from Nigeria.

ILLUSTRATIONS: Trans. Brit. Mycol. Soc. 57: 52, Fig. 1, C-F.

The preceding description is based mostly on the original description, but somewhat modified by comparison with a portion of the paratype, kindly sent by Mr. Ing. It is to be hoped that additional specimens will be collected.

Metatrichia vesparium (Batsch) Nann.-Brem., K. Ned. Akad. Wet. C. 69: 146. 1966.

Lycoperdon vesparium Batsch, Elench. Fung. Contin. 1: 253. 1786.

Stemonitis cinnabarina Roth, Fl. Germ. 1: 547. 1788.

Trichia pyriformis Hoffm., Veg. Crypt. 2: 1. 1790.

Stemonitis vesparium (Batsch) J. F. Gmel., Linn. Syst. Nat. 2: 1470. 1791 (as vesparia).

Trichia fragiformis With., Brit. Pl. ed. 2. 3: 480. 1792.

Trichia rubiformis Pers., Neues Mag. Bot. 1: 89. 1794.

Trichia chalybea Chev., Fl. Paris 1: 323. 1826.

Craterium porphyrium Schw., Trans. Am. Phil. Soc. II. 4: 258. 1832.

Trichia neesiana Corda, Ic. Fung. 1: 23. 1837.

Trichia ayresii Berk. & Br., Ann. Mag. Nat. Hist. II. 5: 367. 1850.

Hemiarcyria rubiformis (Pers.) Rost., Mon. 262. 1875.

Arcyria rubiformis (Pers.) Massee, Mon. 158. 1892.

Hemitrichia rubiformis (Pers.) A. Lister, Mycet. 175. 1894.

Hemitrichia vesparium (Batsch) Macbr., N. Am. Slime-Moulds 203. 1899.

Sporangia stipitate, obovate, usually clustered or crowded, often firmly united into pseudoaethalia, occasionally single but then associated with clustered fruitings, 1–1.5(–2) mm in height, not including the stalk, 0.4–0.7 mm in diameter, the total height up to 3 mm or more, seated on an extensive brownish red hypothallus, wine-red to dark maroon or nearly black; peridium opaque.

FIG. 121 Plate XII firm, shining, with metallic reflections; dehiscence by a preformed dome-shaped lid, not sunken within a raised marginal rim, the basal portion remaining as a deep cup, the clusters, especially when empty, suggesting a miniature wasps' nest; stalks solid, brick red, often fused, supporting clusters of sporangia, rather thick, very variable in height; capillitium of numerous, long, free, rarely branched elaters, almost all of which are bent in the middle with the two halves coiled about each other, the tips bluntly pointed, bearing a prominent spine, ornamented by three or four spiral bands, bearing numerous spines $1-2~\mu$ long, bright red to deep crimson in mass; spores brownish red in mass, reddish orange by transmitted light, globose, minutely warted, $(8-)9-11(-12)~\mu$ in diameter, sometimes ovate or elliptical in outline. Plasmodium deep red to black.

TYPE LOCALITY: Germany.

HABITAT: Dead, usually rotten wood of all sorts; occasionally on leaves.

DISTRIBUTION: Common and widely distributed in north temperate regions; apparently less common in the tropics and the southern hemisphere.

ILLUSTRATIONS: Batsch, Elench. Fung. Contin. 1: pl. 30, f. 172, a-d; Rost.,
Mon. pl. 11, f. 201; Lister, Mycet. ed. 3. pl. 166; Macbr. & Mart., Myxom.
pl. 20, f. 533-535; Hattori, Myxom. Nasu pl. 4, f. 5.

EXSICCATI: Ellis, N. Am. Fungi 1113; Jaap, Myxom. Exs. 57; Brândză, Myxom. Roum. I. 1: 27; III. 2: 28; 74(NY); 34, 81(IA) (as Trichia botrytis); Thaxter, Rel. Farl. 399.

This very distinctive and common species has always seemed as out of place in *Hemitrichia* as it did when it was included in *Trichia*. It is obviously closely related to *Metatrichia horrida* and unless all three genera are to be united in *Trichia*, Ing's genus is the most appropriate place for it.

In a single fruiting, some sporangia may be nearly sessile, while others are mounted on stalks equal to half the total height or more. In the larger pseudo-aethalioid fruitings, there may be numerous groups of short, clustered stalks on the under side.

The Lister monograph cites Stemonitis cinnabarina Roth as a doubtful synonym. Roth himself cites Clathrus denudatus L. as a synonym of his species. His description, brief as it is, fits the present species very well, Arcyria denudata not at all.

Prototrichia

Rost., Mon. App. 38. 1876.

Sporangiate, sessile, rarely short-stipitate or subplasmodiocarpous. Peridium thin, transparent. Capillitium of solid threads, smooth, faintly sculptured or with distinct spiral bands, often twisted about each other in spirals, attached at the base of the sporangium and becoming subdivided above, the penicillate tips attached to the upper wall. Spores at first pinkish then brown in mass, pinkish then yellow by transmitted light.

Type species, Trichia metallica Berk.

In some specimens the capillitium shows little or no evidence of spirals; in most specimens the spirals occur on at least a good proportion of the threads and often on practically all of them, thus suggesting that its place should be in the Trichiaceae, rather than in the Dianemaceae where it formerly was classified.

With a single species.

Prototrichia metallica (Berk.) Massee, Jour. Roy. Micr. Soc. 1889: 350. 1889.

Trichia metallica Berk., in Hook. f., Fl. Tasm. 2: 268. 1859.

Trichia flagellifer Berk. & Br., Ann. Mag. Nat. Hist. III. 18: 56. 1866.

Prototrichia flagellifer (Berk. & Br.) Rost., Mon. App. 38. 1876.

Prototrichia elegantula Rost., Mon. App. 39. 1876.

Prototrichia cuprea Massee, Jour. Roy. Micr. Soc. 1889: 351. 1889.

Prototrichia chamaeleontina Massee, Mon. 130. 1892.

Prototrichia schroeteri Meylan, Bull. Soc. Vaud. Sci. Nat. 53: 462. 1921.

Sporangiate, sessile on a constricted base or less commonly short-stalked, rarley subplasmodiocarpous, 0.5–2.2 mm in diameter, orange-brown to dull brown, sometimes rosaceous; peridium thin, transparent, iridescent, bearing on its inner surface the persistent ends of the capillitial threads; capillitium of numerous yellow-brown, more or less spirally banded threads which appear solid, originating at the base and becoming subdivided as they ascend, the branches often spirally interwoven, sometimes anastomosing to form a network at the bases and tips, many of the extremities attached to the upper wall, spirals occasionally lacking and capillitium often irregular; spores orange-brown to brown in mass, yellow by transmitted light, spiny, 10-13(-15) μ in diameter. Plasmodium white.

TYPE LOCALITY: Tasmania.

HABITAT: Dead wood and bark, usually of conifers.

DISTRIBUTION: Tasmania; widely distributed in Europe; in North America, mainly in the west, Alberta to Washington, south to Colorado and California; reported from North Carolina.

ILLUSTRATIONS: Massee, Mon. pl. 5, f. 127-132; Lister, Mycet. ed. 3. pl. 195; Macbr. & Mart., Myxom. pl. 18, f. 478-480.

All three editions of the Lister monograph refer to the spores as pink or pinkish brown. This is repeated by Hagelstein. In our numerous collections, including seven from England, the spores are never pink, either in mass or when mounted. They are yellow-brown, orange-brown or red-brown in mass; yellow when mounted.

The European collections are mostly smaller than those from our western mountains, with a thinner, more iridescent wall, but these characters do not seem to justify even a varietal name. Lister notes that the spirals are often partly or even entirely lacking and that the capillitium may be quite irregular. In all such collections we have seen, the sporangia are characteristic and would be accepted without question as representing this species.

Hemitrichia

Rost., Versuch 14. 1873.

Hyporhamma Corda, Ic. Fung. 6: 13. 1854. (nomen confusum). Hemiarcyria Rost., Mon. 261. 1875.

Fructification sporangiate, either stalked or sessile, or plasmodiocarpous. Peridium membranous or subcartilaginous, usually persistent below as an irregular cup, usually thinner and more or less fugacious above. Stalk, when present, solid or filled with spore-like vesicles or amorphous material. Capillitium of tubular threads united more or less completely into an elastic net, with or without free ends, and ornamented with two or more usually conspicuous spiral

FIG. 66 Plate VI bands. Spores red, orange, or yellow in mass, bright and pale by transmitted light.

Type species, Trichia clavata Pers.

As indicated under Arcyria and Trichia, these genera, as well as Hemitrichia, include species which are in some degree intermediate and would fit nearly as well in one of the other two. Occasionally, as mentioned in the Lister monograph, the capillitium is broken up into free elaters. Care should be taken to make allowance for that fact before describing such forms as new.

In this and other genera with spiral structures, the terms dextrorse and sinistrorse are used as defined by Jackson, Gloss. Bot. ed. 4, 477, 1928, and by Snell and Dick, Gloss. Myc. 1957, i.e., a dextrorse spiral seems to climb the underlying structure bearing to the right in a clockwise direction; a sinistrorse spiral suggests the opposite direction. However, other authors, including the Listers, have used the two terms in an exactly opposite, and incidentally older, sense.

KEY	TO S	PECIES			
a.	Spo	res coarsely and prominently reticulate.	b		
a.		res nearly smooth to spiny or warted or, if reticulate, culations faint and visible only under high magnification.	c		
	b.	Fructifications plasmodiocarpous, usually large and netted; capillitium spiny.	H. serpula		
	b.	Sporangiate or forming small plasmodiocarps; capillitium not spiny.	H. chrysospora		
c.		res and capillitium in mass dull orange to	U матадода		
c.	Spo	k-red; peridium bearing conspicuous dark warts. res and capillitium usually yellow, etimes reddish brown but never	H. paragoga		
		k-red; peridium not bearing conspicuous warts.	d		
	d.	Primarily plasmodiocarpous, but often associated with pulvinate or globose sporangia.	H. karstenii		
	d.	Primarily sporangiate, rarely approaching plasmodiocar	pous. e		
e.		rangia cylindrical, often distorted,			
		per-colored to reddish brown, densely tered, sometimes joined to form simple pseudoaethalia.	f		
c.		orangia usually globose to pyriform, rarely ndrical and then without coppery tints, usually free.	g		
	f.	Spirals of capillitium poorly and irregularly developed, often associated with spines and rings.	(Arcyria stipata)		
	f.	Spirals of capillitium strongly developed, without spines or rings, otherwise similar to A. stipata.	H. imperialis		
g.	Spo	rangia sessile or with thick, short stalks.	h		
g.	Spo	Sporangia usually with well-developed stalks, rarely short-stalked or sessile.			
	h.	Sporangial wall typically hyaline, iridescent,	•		
		sometimes encrusted; capillitium with 2-4 smooth spira	als. H. abietina		
	h.	Sporangial wall usually opaque; capillitium with 4-6 s	pirals. i		

Sporangia large, wide in proportion to height; peridium pale yellow; capillitium with 5-6 spirals.

Sporangia of medium size; peridium dull yellow

or olivaceous; capillitium usually with 4-5 spirals. Stalk hollow, filled with spore-like cysts; sporangia gravish or

ochraceous, closely resembling Arcyria cinerea.

i

H. montana

H. leiotricha

(Arcyria leiocarpa)

i.

j. Stalk solid or hollow; sporangia bright yellow to yellow-brown.

Capillitium distinctly spiny.

k. Capillitium smooth or minutely roughened, not spiny.

Stalk expanding upward, merging gradually into the deep vase-like cup; capillitium minutely roughened. H. clavata

 Stalk cylindrical to base of peridium, distinct from the rather shallow cup; capillitium nearly smooth.

H. stipitata

H. intorta

k

Hemitrichia abietina (Wigand) G. Lister, Mycet, ed. 2. 227. 1911.

Trichia abietina Wigand, Jahrb. Wiss. Bot. 3: 33. 1863.

Trichia nana Massee, Jour. R. Micr. Soc. 1889: 336. 1889. Not T. nana Zukal, 1885.

Hemiarcyria wigandii Rost., Mon. 267. 1875.

Arcyria wigandii (Rost.) Massee, Mon. 163. 1892.

Hemitrichia ovata Macbr., N. Am. Slime-Moulds ed. 2. 261. 1922.

Sporangia closely gregarious or crowded, on an expanded iridescent hypothallus, sometimes gregarious, sessile on a constricted base or short-stalked, subglobose or turbinate, 0.3–0.7 mm in diameter, shining yellow to orange; peridium thin, iridescent, or sometimes more or less encrusted, dehiscent irregularly above, the basal portion remaining as a persistent cup; stalk, when present, ochraceous, 0.1–0.3 mm long, filled with spore-like cells; capillitium an open network of sparingly branched and anastomosing yellow threads 3–5 μ in diameter, bearing 2–4 loose, somewhat irregular spirals, without spines, with a few inflated or rounded free ends; spores yellow in mass, pale yellow by transmitted light, appearing distinctly verrucose under a dry lens, but delicately reticulate under oil, 9–12 μ in diameter. Plasmodium rose.

TYPE LOCALITY: Germany.

HABITAT: Dead wood.

DISTRIBUTION: Great Britain, Scandinavia, western and central Europe, Greece; in North America, Maine and Ontario to Oregon, south to Virginia and California; Japan; Samoa.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 168, c-e; Macbr. & Mart., Myxom. pl. 20, f. 530-532.

EXSICCATI: Jaap, Myxom. Exs. 58.

This species appears to be rather uncommon although widely distributed. The thin iridescent peridium, particularly in the sessile forms, suggests *Trichia lutescens* and the capillitium is not unlike that of *T. varia*, in which the peridium may occasionally be delicate. On the whole, however, it seems to be sufficiently distinct to deserve recognition. The varieties *lutea* and *aurantiaca* Meylan, Bull. Soc. Vaud. Sci. Nat. 46: 53. 1910, were named for color variants which are well within the range of a single species and seem to have no usefulness.

Hemitrichia chrysospora (A. Lister) A. Lister, Mycetozoa 178. 1894.

Hemiarcyria chrysospora A. Lister, Grevillea 15: 126. 1887.

Arcyria chrysospora (A. Lister) Massee, Mon. 164. 1892.

Fructifications sporangiate, globose, sessile, crowded or scattered, or forming elongate curved plasmodiocarps, 0.25–0.5 mm broad, yellowish brown, red-brown or purplish brown; peridium membranous, the outside often thick-

FIG. 113 Plate XI

Plate XLI

FIG. 367

ened with granular deposits; capillitium of branching yellowish or reddish brown threads, 3–5 μ in diameter, marked with 3–5 more or less distinct spiral bands in close regular spirals, without spines, and connected by longitudinal striae, the threads with short-pointed free ends, often attached to sporangium wall; spores reticulate, the bands narrow, sharply defined, forming a regular net with 6–9 meshes to the hemisphere, 14–18 μ in diameter, the border 1.5–2 μ broad. Plasmodium unknown.

TYPE LOCALITY: Lyme Regis, England.

HABITAT: Fallen leaves and litter, especially of larch, and dead wood.

DISTRIBUTION: England; Holstein.

ILLUSTRATION: Lister, Mycet. ed. 3. pl. 169.

The description is based on that in the third edition of the Lister monograph, which suggests relationship with *Trichia verrucosa*. That and the acompanying illustration give an excellent idea of this rare species. The large, coarsely reticulate spores are somewhat similar to those of *H. serpula*, but plasmodiocarpous fruitings of *H. chrysospora* should be distinguished readily from small plasmodiocarps of *H. serpula* by the spineless capillitium with closely wound spirals and the somewhat larger spores. We have no specimens.

Hemitrichia clavata (Pers.) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27-28: 75. 1873.

FIG. 114 Plate XII Trichia clavata Pers., Neues Mag. Bot. 1: 90. 1794.

Hemiarcyria clavata (Pers.) Rost., Mon. 264. 1875.

Arcyria clavata (Pers.) Massee, Mon. 165. 1892.

Hemiarcyria ablata Morgan, Jour. Cinc. Soc. Nat. Hist. 16: 24. 1893.

Hemiarcyria funalis Morgan, Jour. Cinc. Soc. Nat. Hist. 16: 26. 1893.

Sporangia stalked, gregarious or crowded, broadly clavate or pyriform, 1–2 mm tall, olivaceous yellow; peridium shining, dehiscent above, one-half to two-thirds remaining as a goblet-shaped calyculus, marked within by rather coarse papillae or broken reticulations; stalk rather short, attenuated downwards and merging gradually above into the base of the sporangium, hollow, filled with spore-like cells, yellow above, shading into reddish brown below, arising from the thin, dark, reddish brown hypothallus; capillitium yellow or somewhat olivaceous, somewhat elastic, the threads 4.5–6.5 μ in diameter, closely wound with four or five spirals, minutely pilose, with occasional free ends, these often swollen, obtuse or tipped with a broad-based apiculus 2–4 μ long; spores pale yellow by transmitted light, globose or subglobose, coarsely papillate, the papillae frequently elongated into ridges which form a more or less complete reticulation visible only under high magnification, 7–9 μ in diameter. Plasmodium white.

TYPE LOCALITY: Germany.

HABITAT: Dead wood.

DISTRIBUTION: Widely distributed in cool temperate regions.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 167, a-e (not f); Proc. Iowa Acad.

38: 109, f. 5-8; Macbr. & Mart., Myxom. pl. 20, f. 536-538.

EXSICCATI: Ellis, N. Am. Fungi 523; Brândză, Myxom. Roum. 80(IA); Thaxter, Rel. Farl. 398; Jaap, Myxom. Exs. Nachl. 1: 14.

The concept of this species in the Lister and Hagelstein monographs is extremely broad, including H. stipitata and H. montana, which seem to us quite dis-

tinct. *H. clavata* (Pers.) Rost., is really a species complex. However, because of this, the synonymy of the species involved is very uncertain. All tropical collections referred to *H. clavata* which we have seen have proved to be what we regard as *H. stipitata*.

H. clavata is readily distinguished from H. stipitata by its vase-like aspect, the peridium merging gradually into the thick, short stipe, the much deeper cup, the rougher capillitium and the slightly larger and usually somewhat reticulate spores; from H. montana by the characters of the stalk, the narrower and spineless capillitium and the smaller spores.

Hagelstein (1944, p. 241), in his account of this species, followed G. Lister (1925) very closely, ignoring the careful study of Baskerville (1932) in which the differences between H. clavata and H. stipitata are clearly described and illustrated.

Hemitrichia imperialis G. Lister, Trans. Brit. Mycol. Soc. 14: 226. 1929.

Sporangia clustered, short-stalked or sessile, cylindrical, curved, 0.8–1.5 mm tall, pale copper-colored, fading to dull tawny; peridium tending to be persistent, smooth or marked with transverse wrinkles below; stalk nearly black, up to 0.3 mm in height, filled with vesicular bodies; capillitium of sparsely branched, flexuose threads, marked with three or four prominent spiral bands, 4–4.5 μ in diameter, smooth or spinulose, united into a loose net with few or no free ends and free from the sporangium wall; spores pale copper colored in mass, fading to dull yellow, smooth or with a few faint scattered warts, 6.5–7 μ in diameter. Plasmodium white.

TYPE LOCALITY: Tokyo, Japan.

HABITAT: Dead wood.

DISTRIBUTION: Known from three localities in Japan; India.

ILLUSTRATION: Trans. Brit. Mycol. Soc. 14: pl. 4.

Externally much like Arcyria stipata, differing chiefly in the more strongly developed spirals on the capillitium, as noted by the author. The occurrence in three different localities in Japan (Emoto, 1931) suggests that the form is constant in Japan, but it may still be no more than a variety of A. stipata. A specimen from India, communicated by Dr. Thind, appears to confirm this.

Hemitrichia intorta (A. Lister) A. Lister, Mycet. 176. 1894.

Hemiarcyria intorta A. Lister, Jour. Bot. 29: 268. 5 S 1891.

Hemiarcyria longifila Rex, Proc. Acad. Phila. 43: 396. 22 S 1891.

Sporangia gregarious, stalked, or sessile on a constricted base, turbinate or pyriform, 0.3–0.7 mm broad, golden yellow to reddish brown; peridium thin, translucent, shining, sometimes encrusted, opening irregularly above, the lower portion remaining as a deep cup; stalk dark red-brown, solid, rugulose, 0.1–0.5 mm tall, sometimes lacking; capillitium consisting of a small number of long, orange-yellow threads, sparingly branched, but looped and intertwisted, 3–4 μ in diameter, bearing four or five even and regular, spinulose spirals, connected by conspicuous longitudinal striae; spores golden yellow in mass, yellow by transmitted light, delicately warted, 8–10 μ in diameter. Plasmodium watery white.

TYPE LOCALITY: England. HABITAT: Dead wood.

DISTRIBUTION: England; in North America, reported from Massachusetts to

FIG. 115 Plate XII Ontario, south to Pennsylvania and Iowa, but some of the reports are dubious; Ceylon.

ILLUSTRATIONS: Jour. Bot. 29: pl. 312, f. 3; Lister, Mycet. ed. 3, pl. 172, a, b.

This is apparently a rare species. It resembles in appearance a small, dark form of *H. clavata* and it is not surprising that some such specimens of that species have been referred to *H. intorta*. The capillitium of the two species is quite different, however. That of *H. clavata* is larger, spineless, and with a characteristic rough, minutely pilose, hyaline outer sheath, while the spirals of *H. intorta* are densely spiny. The capillitium of *H. clavata* has frequent anastomoses and forms a true net, while that of *H. intorta* is composed of a small number of threads with few, if any, branches, but the individual threads are wound in close spirals.

Our best specimen was collected by Dr. R. K. Benjamin in northwestern Illinois. The capillitium agrees exactly with that of a small example, presumably from England, sent by A. Lister to Macbride. In the Illinois collection, most of the sporangia are sessile on a restricted base; a few are short-stalked.

The names of Lister and of Rex were published almost simultaneously. Lister (Mycet. 176. 1894) says Rex's name was published "a few months later." This can scarcely be the case, since the number of the Proceedings in which it was printed was issued September 22, 1891. Dr. G. C. Ainsworth finds that the Linnean Society's copy of the September issue of the Journal of Botany was received in London on September 5, which gives Lister's name clear priority.

Hemitrichia karstenii (Rost.) A. Lister, Mycet. 178. 1894.

FIG. 116 Hemiarcyria karstenii Rost., Mon. App. 41. 1876.

Hemiarcyria paradoxa Massee, Jour. Roy. Micr. Soc. 1889: 356. 1889.

Hemiarcyria obscura Rex, Proc. Acad. Phila. 43: 395. 1891.

Arcyria paradoxa (Massee) Massee, Mon. 160. 1892.

Arcyria karstenii (Rost.) Massee, Mon. 168. 1892.

Perichaena cornuvioides Čelak. f., Arch. Nat. Land. Böhmen 7(5): 26. 1893. Trichia contorta var. karstenii (Rost.) B. Ing, Trans. Brit. Mycol. Soc. 48: 647. 1965.

Fructification sporangiate, pulvinate, varying to elongate or to short, unbranched or sparsely branched plasmodiocarps, 0.3–0.5 mm broad, yellowish brown to deep reddish brown or nearly black; peridium membranous, tending to become thickened with granular deposits, often approaching cartilaginous; capillitium and spores yellow in mass, the threads bearing 4–6 spiral bands, often irregular, with expansions and rings; spores yellow by transmitted light, minutely roughened, $10-14~\mu$ in diameter. Plasmodium watery-white.

TYPE LOCALITY: Finland.

HABITAT: Dead wood.

DISTRIBUTION: Europe; Ceylon; Japan; Pennsylvania, Ontario, Illinois, Iowa, Colorado, Montana, Washington.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 171; Hattori, Myxom. Nasu pl. 23, f. 3.

Various authors, including A. Lister (1894), Jahn (1918), and Hagelstein (1944) have noted the resemblance of this species to *Trichia contorta*. Lister suggested it might be a form of that species, and Ing proposed it formally as a variety. This may well be the case. The very faint spirals on the Finland type and other collections make Čelakovsky's assignment of his collection to *Perichaena* not unreasonable. The spirals on the elaters of other collections, notably that from Iowa, are more strongly marked and more regular. We have a small specimen sent by Karsten to Wingate, marked as the type and a similar specimen, surely

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FIG. 116 Plate XII a portion of the same collection, sent by Karsten to Morgan. A. Lister referred to the Ceylon collection as the type, but the fact that Rostafinski named it after Karsten and the latter evidently considered his collection to be the type, should be decisive in this instance.

If this is no more than a phase of *T. contorta*, which, however, cannot yet be regarded as established, then it is further evidence of the artificial nature of the generic distinctions in the Trichiaceae.

Hemitrichia leiotricha (A. Lister) G. Lister, Mycetozoa ed. 2. 224. 1911.

Hemitrichia intorta var. leiotricha A. Lister, Mycetozoa 176. 1894.

Sporangiate, stalked, rarely sessile, shining dull yellow or olivaceous, subglobose, scattered, 0.5–0.9 mm in diameter; sporangium wall usually of two layers, the outer composed of scattered deposits of dark brown refuse matter, the inner translucent, marked with scattered ring-shaped or crescentic thickenings; stalk short, stout, brown or black, 0.1–0.3 mm high; capillitium a twisted tangle of sparingly branched smooth yellow threads, with few to many rounded or pointed free ends, marked with 3–6 often faint spiral bands, 3–4 μ in diameter; spores yellow or olivaceous, minutely warted, 9–13 μ in diameter. Plasmodium watery white.

TYPE LOCALITY: Great Britain. HABITAT: Litter of woody plants.

DISTRIBUTION: Great Britain, Scandinavia, Germany, Switzerland; Ceylon;

Kansas.

ILLUSTRATIONS: Lister, Mycetozoa ed. 3, pl. 172, c, d.

This species appears to be closest to *H. intorta*, of which it was originally described as a variety. Our only collection is from Kansas (Brooks 3163) and, if it is correctly referred, it suggests that the species should be reduced to its original status as a variety of *H. intorta*.

Hemitrichia montana (Morgan) Macbr., N. Am. Slime-Moulds 208. 1899.

Hemiarcyria montana Morgan, Jour. Cinc. Soc. Nat. Hist. 18: 40. 1895.

Hemitrichia clavata var. montana (Morgan) Meylan, Bull. Soc. Vaud. Sci.

Nat. 53: 461. 1921.

Sporangia densely gregarious or clustered on a common hypothallus, flattened-globose or globose to obovate or pyriform, pale yellow to dull ochraceous, sessile on a constricted base or short-stalked, 1–2 mm in diameter, rarely subplasmodiocarpous; peridium thin, shining, translucent or sometimes appearing dull when thickened by spore deposits, delicately reticulate within, breaking away in patches above, but persisting below as a deep cup with more or less petaloid lobes; stalk, when present, short, thick, rarely exceeding one-third of the total height, merging gradually into the cup; capillitium dense, compact, only moderately elastic, bright yellow to ochraceous orange, becoming duller and darker with age, branching and anastomosing, with few to many free ends and often with vesicular enlargements, 6–8(–11) μ in diameter, bearing 4–6 spiral bands, close-set to loose in the same sporangium, and occasional rings and scattered spines, the basal portions tending to be wider and smoother; spores globose, bright ochraceous in mass, almost colorless by transmitted light, minutely spinulose, 10–13 μ in diameter. Plasmodium unknown.

FIG. 117 Plate XII TYPE LOCALITY: San Bernadino Mts., California.

HABITAT: Dead wood.

DISTRIBUTION: Colorado, Washington, California; Switzerland. ILLUSTRATION: Jour. Cinc. Soc. Nat. Hist. 18: pl. 2, f. 12.

This species is combined with H. clavata by G. Lister, in the second and third editions of the Lister monograph, and by Hagelstein; they also include H. stipitata in that species. H. montana differs from both in its flattened shape, paler color and generally larger size as well as in its larger spores and wider capillitium.

Hemitrichia paragoga Farr, Bull. Inst. Jamaica, Sci. Ser. 7: 34. 1957.

FIG. 118 Plate XII

Sporangiate, stalked, gregarious, subglobose to broadly pyriform, up to 4 mm in total height, 0.5-0.7 mm in diameter, the stalks sometimes united, blackish at base, the rounded upper portion of the sporangium dull rose, bearing sparsely scattered conspicuous dark warts; dehiscence apical, irregular above, leaving a clearly defined cup below; stalks 3-4 times the diameter of the sporangium, longitudinally furrowed, shining, reddish brown, expanded and darker above where they merge into the sporangium, lighter, clear, translucent, often flattened below, arising from a blackish to reddish brown hypothallus; capillitium and spores dull orange to pale brick-red in mass, dilute reddish brown under the microscope; peridium membranous, pale reddish, translucent, with a uniform pattern of delicate stippled lines when seen with an oil immersion objective, the warts on the upper surface appearing as opaque, red-brown, irregularly thickened areas; capillitium of many long threads with numerous recurved and spirally twisted loops, 5-6 μ in diameter, with rather loosely and irregularly wound, densely spiny spirals, the spines delicate, up to 3.5 µ long, the free ends drawn out into long, tapering tips; spores 8-9 μ in diameter, uniformly and delicately warted. Plasmodium black at time of fruiting.

TYPE LOCALITY: John Crow Mts., Jamaica.

HABITAT: Dead wood.

DISTRIBUTION: Jamaica, Dominica.

ILLUSTRATIONS: Bull. Inst. Jamaica, Sci. Ser. 7: f. 3, a, b; f. 4.

In its spores and capillitium and in its reddish colors, this species suggests Metatrichia vesparium, and, as in that species, there is a tendency for the sporangia to be united by their stalks. However, the relatively small sporangia, the long stems, the shallow broad cup and especially the prominent warts on the peridium make it impossible to regard this species as no more than an aberrant phase of M. vesparium. It may, however, be better referred to Metatrichia.

Hemitrichia serpula (Scop.) Rost., in Lister, Mycet. 179. 1894.

FIG. 119 Plate XII

Mucor serpula Scop., Fl. Carn. ed. 2. 2: 493. 1772. Lycoperdon lumbricale Batsch, Elench. Fung. Contin. 1: 259. 1786.

Trichia spongioides Vill., Hist. Pl. Dauph. 1061. 1789.

Stemonitis lumbricalis (Batsch) J. F. Gmel., Syst. Nat. 2: 1470. 1791.

Trichia reticulata Pers., Tent. Disp. Fung. 10. 1797.

Trichia serpula (Scop.) Pers., Tent. Disp. Fung. 10. 1797.

Trichia venosa Schum., Enum. Pl. Saell. 2: 207. 1803.

Trichia retiformis Payer, Bot. Crypt., f. 574. 1850.

Hyporhamma reticulatum (Pers.) Corda, Ic. Fung. 6: 13. 1854.

Hemiarcyria serpula (Scop.) Rost., Mon. 266. 1875.

Arcyria serpula (Scop.) Massee, Mon. 164. 1892. Not A. serpula Wigand, 1863.

Fructification plasmodiocarpous, often covering several square centimeters, plasmodiocarps terete, branching freely and usually everywhere reticulate, bright yellow, rusty, or tawny; peridium thin, transparent, with irregular, longitudinal dehiscence; hypothallus like the peridium or a little darker, the margins between adjoining segments often separated by a black line; capillitium variable, a tangle of long, yellow threads, sparingly branched, free everywhere except below, spinulose, the free tips spiny, the spirals three or four, with traces of longitudinal striae, 4-6(-8) μ in diameter; spores golden yellow in mass, pale yellow by transmitted light, globose, coarsely reticulate, 11-16 μ in diameter. Plasmodium white, then yellow.

TYPE LOCALITY: Austria.

HABITAT: Dead wood, leaves and plant litter.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Batsch, Elench. Fung. Contin. 1: pl. 30, f. 174, a-c; Lister, Mycet. ed. 3. pl. 170, a-c; Macbride & Mart., Myxom. pl. 20, f. 524-526; Hattori, Myxom. Nasu pl. 13, f. 2; Hagelst., Mycet. N. Am. pl. 14, f. 2. EXSICCATI: Ellis & Ev., N. Am. Fungi 2499; Brândză, Myxom. Roum. I. 1: 28; III. 2: 27, 73(NY); 79(IA); Thaxter, Rel. Farl. 400 a, b.

A striking and extremely common species, occurring both in temperate and tropical areas. Curiously, according to Lister it is known from Britain only from a development in a greenhouse. A collection from West Pakistan, otherwise typical, has elaters $8~\mu$ in diameter.

Hemitrichia stipitata (Massee) Macbr., N. Am. Slime-Moulds 207. 1899.

Hemiarcyria stipitata Massee, Jour. Roy. Micr. Soc. 1889: 354. 1889.

Arcyria stipitata (Massee) Massee, Mon. 163. 1892.

Hemiarcyria plumosa Morgan, Jour. Cinc. Soc. Nat. Hist. 16: 23. 1893.

Sporangia stalked, scattered, rarely crowded, globose or turbinate, olivaceous yellow, 1–3 mm tall; hypothallus thin, dark reddish brown; stalk dark reddish brown, 0.5–2 mm in length, slender, uniform in diameter and color, filled with spore-like cells; peridium thin, dull yellow, opening above, one-half or less persistent as a petaloid calyculus, finely papillate or delicately reticulate within; capillitium yellow, dense, netted, elastic, with few free ends, these obtuse, the threads 5–7 μ in diameter, with four or five spirals, smooth; spores globose, yellow, minutely spinulose or delicately reticulate, 7–8 μ in diameter. Plasmodium yellow, turning red in fruiting.

TYPE LOCALITY: Java. HABITAT: Dead wood.

DISTRIBUTION: World-wide and common in temperate and tropical regions. ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 167, f (as H. clavata); Proc. Iowa Acad. 38: 109, f. 1-4; Macbr. & Mart., Myxom. pl. 20, f. 539, 540.

EXSICCATI: Brândză, Myxom. Roum. 72(NY) (as H. clavata); Thaxter, Rel. Farl. 398 (as H. clavata).

FIG. 120 Plate XII Readily distinguished in the field from *H. clavata* by the slender, nearly cylindrical stem, the much shallower cup with the large, reflexed lobes and usually the general habit of growth, which is scattered or in small clusters in *H. stipitata* and usually in very large and dense colonies in *H. clavata*. Microscopically, the capillitium of *H. clavata* is usually much rougher than that of *H. stipitata*.

EXCLUDED AND DOUBTFUL SPECIES

Hemiarcyria calyculata Speg., Anal. Soc. Ci. Arg. 10: 152. 1880.

Cited by Berlese, in Sacc., Syll. 7: 449. 1888, by Massee, and in all three editions of the Lister monograph. Spegazzini may have published it as *Hemitrichia calyculata*. Probably *Hemitrichia stipitata*.

Hemiarcyria expansa (Martius) Sacc. & Sacc., Syll. 18: 212. 1906.

Based on Trichia expansa Martius, q.v.

Hemiarcyria pusilla (Speg.) Berlese, in Sacc., Syll. 7: 450. 1888.

Based on Hemitrichia pusilla Speg., q.v.

Hemiarcyria varneyi Rex, Proc. Acad. Phila. 43: 396. 1891.

A member of the *Hemitrichia clavata* group according to the Lister monograph.

Hemitrichia helvetica Meylan, Bull. Soc. Vaud. Sci. Nat. 46: 54. 1910.

Regarded by G. Lister, Mycet. ed. 3. 205, as a form of *T. scabra* with elaters united to form a net.

Hemitrichia pusilla Speg., Ann. Soc. Ci. Arg. 12: 257. 1881.

Hemiarcyria pusilla (Speg.) Berlese, in Sacc., Syll. 7: 450. 1888; Arcyria pusilla (Speg.) Massee, Mon. 168. 1892. See Lister, Mon. ed. 2. 231 and ed. 3. 226. A minute red species, possibly a Hemitrichia worthy of recognition.

Trichia

Haller, Hist. Stirp. Helv. 3: 114. 1768.

Sporangiate, stipitate or sessile, or subplasmodiocarpous. Peridium membranous or cartilaginous. Capillitium elastic, of free, simple or sparsely branched elaters, acuminate at the tips and marked with 2–5, rarely more, spiral bands. Spores yellow, yellow-brown or reddish in mass, hyaline, tinted by transmitted light.

Type species, Trichia gregaria sessilis, piriformis flava Haller, Hist. Stirp. Helv. 3: pl. 48, f. 7. 1768 (=T. ovata Pers., now equated with T. varia).

KEY TO SPECIES

 Typically sessile, sporangiate to plasmodiocarpous, sporangia rarely short-stalked.

b

h

d

a. Typically sporangiate and stalked, the stalks distinct, usually half or more of total height, rarely short-stalked or sessile.

T. varia

b. Elaters with two, rarely three, spirals, these tending to be open and loose.

1. Carta

 Elaters with at least three, usually more spirals, these tending to be close and tight.
 Spores coarsely and prominently reticulate.

T. favoginea

c. Spores spinulose or minutely warted, or, if reticulate, reticulations delicate, visible only under high magnification.

d. Spores large, 13–18 μ in diameter; sporangia dark purple to black.

T. alpina

d. Spores rarely exceeding 13 μ in diameter.

e. Fructifications umber brown to dark ochraceous; spores brown in mass.

T. macbridei

f sometimes darker with age; spores ochraceous in mass. Dull vellowish or reddish brown becoming blackish when old; wall thickened with granular deposits. T. contorta Peridium olive or yellow, delicate, shining. Scattered or in small clusters; T. lutescens elaters smooth, 3-4.5 μ ; spores warted. Crowded or in extensive fruitings; g. T. scabra elaters spiny, 5-6 μ ; spores delicately reticulate. Spores coarsely and prominently reticulate; T. verrucosa peridium papillose; elaters with short tips. Spores warted or spinulose or very delicately reticulate. i. Elaters spinulose; sporangia brown, T. erecta mottled; spore-mass yellow or orange. j i. Elaters spineless or nearly so. Elaters of uniform thickness except at the short, often blunt, tips; sporangia subglobose or somewhat pyriform. T. subfusca Elaters with long, slender, tapering k tips; sporangia usually turbinate or pyriform. Sporangia top-shaped, dehiscent by a flat, membranous operculum; elaters $7-8 \mu$ in diameter, uniform at T. crateriformis the center, but with long, tapering tips. Sporangia dehiscent by lobes or irregularly above; elaters usually less than 6μ in diameter 1 at center, tapering gradually from there to tips. Spore-mass ochraceous to brown; stalk brown, opaque. T. botrytis Spore-mass not ochraceous to brown; stalk translucent, at least above. m Spore-mass olivaceous yellow; stalk dark brown below, paler above, filled with spore-like cells; dehiscence irregular, leaving a cup-like base. T. decipiens Spore-mass brick-red; stalk deep red, not filled with spore-like cells. T. floriformis

Fructifications yellow to reddish brown,

e.

Trichia alpina (R. E. Fries) Meylan, Bull. Soc. Vaud. Sci. Nat. 53: 460. 1921. Trichia contorta var. alpina R. E. Fries, Ark. Bot. 6(7): 5. 1906.

Trichia cascadensis H. C. Gilbert, in Peck & Gilbert, Am. Jour. Bot. 19: 145. 1932.

Fructifications sessile, sporangiate, varying to pulvinate or plasmodio-carpous, scattered or clustered, (0.2–)0.5–0.7 mm broad on a very delicate hypothallus, dark chestnut or brownish purple to black; peridium cartilaginous, usually tough, the outer portion composed of granular deposits on an inner translucent, yellow or olivaceous layer; elaters dull yellow to dull yellow-brown in mass, bright yellow by transmitted light, 6–8(–10) μ wide, marked with 3–6 spiral bands, often with warts between the bands; spores globose or somewhat irregular, minutely spinulose, dull ochraceous to dull orange in mass, pale yellow by transmitted light, 14–18 μ in diameter. Plasmodium orange-red.

TYPE LOCALITY: Sweden.

HABITAT: Dead wood and herbaceous stems, especially in the vicinity of melting snow banks in mountainous regions.

FIG. 99 Plate X DISTRIBUTION: Europe; New England, Quebec, Ontario, Washington, Oregon, California; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 162, c, d; Am. Jour. Bot. 19: pl. 13,
 f. 8; Hattori, Myxom. Nasu pl. 3, f. 6.

EXSICCATI: Jaap, Myxom. Exs. 138.

Gilbert noted that *T. cascadensis* was closely related to *T. alpina* but believed that the wider elaters and the single wall of *T. cascadensis* as opposed to the narrower elaters and double wall of *T. alpina* justified specific distinction. Comparison of adequate material of both forms, including the type of *T. cascadensis* and two authentic specimens of *T. alpina* determined by Meylan, indicates that the peridium is essentially the same in both and that the capillitial differences may represent only a variation which may reasonably be expected in a single species. Therefore, with some reservation, we include them for the present as a single species.

The distinctive characters are the dark color, the very large spores and the wide elaters. *Trichia contorta*, of which this was originally described as a variety, is smaller, with somewhat smaller spores and more slender capillitium.

Trichia botrytis (J. F. Gmel.) Pers., Neues Mag. Bot. 1: 89. 1794.

FIG. 100 Plate X Stemonitis botrytis J. F. Gmel., Syst. Nat. 2: 1468. 1791.

Trichia serotina Schrad., Jour. Bot. Schrad. 2: 67. 1799.

Sphaerocarpus fragilis Sow., Engl. Fungi, pl. 279. 1800.

Trichia lorinseriana Corda, Ic. Fung. 1: 23. 1837, (as lorinzeriana Cda., Lister, Mon. eds. 2, 3.).

Trichia purpurascens Nyl., Not. Sällsk. Faun. Fl. Fenn. 4: 126. 1859.

Trichia fragilis (Sow.) Rost., Mon. 246. 1875.

Trichia carlyleana Massee, Jour. Roy. Micr. Soc. 1889: 329. 1889.

Sporangia stalked, rarely sessile or subplasmodiocarpous, turbinate or pyriform, 0.6–0.8 mm in diameter, total height (1-)2-4(-5) mm, often clustered on united stalks, dull olive-yellow to reddish or purplish brown, sometimes almost black; peridium double, the inner layer membranous, the outer composed of dark granular thickenings, sometimes lacking, often separating before dehiscence and forming areolae separated by the lighter inner wall; dehiscence irregular; stalk cylindric, dull yellow or dark reddish or purplish brown, opaque, filled with amorphous material; spores and capillitium dull yellow to dingy ochraceous brown in mass; elaters simple or sometimes branched, bearing 3–5 smooth spirals, 4–5 μ in diameter at the center, tapering gradually to the long, slender, acuminate tips; spores pale by transmitted light, minutely warted, 9–11 μ in diameter. Plasmodium purple-brown.

TYPE LOCALITY: Germany.

HABITAT: Dead wood, rarely on leaves.

DISTRIBUTION: Widely distributed in temperate regions; West Pakistan; India; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 163, a-d, j-k; Macbr. & Mart., Myxom. pl. 20, f. 521, 522; Hattori, Myxom. Nasu pl. 4, f. 3.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2097; Sydow, Myc. Germ. 450; Jaap, Myxom. Exs. 56; Brândză, Myxom. Roum. 109(NY); 55, 56 (IA).

This species is to be distinguished from *T. floriformis*, its nearest relative, chiefly by the ochraceous or brownish color of the spore mass and the opaque stem. It is extremely variable and several varieties are recognized in the Lister and Hagelstein monographs. These are: var. *munda* A. Lister, Jour. Bot. 25: 216. 1897, not

clearly separated from the typical form; var. flavicoma A. Lister, Mycet. ed. 1. 172. 1894, for minute fructifications with yellow elaters and spores; and var. cerifera G. Lister, Jour. Bot. 53: 211. 1915, for sporangia spotted with patches of yellow wax. We have not seen specimens bearing wax, but the other two varieties, as described, appear to merge imperceptibly into what the Listers regard as the typical representatives of the species, which automatically becomes var. botrytis if any of the named varieties are recognized. None of our specimens labelled var. flavicoma has a bright yellow mass of spores and capillitium; all are dull yellow, from Colonial Buff through Chamois to Clay Color of Ridgway.

The species appears to be extremely abundant in the coniferous forests of Washington and Oregon, often forming large fruitings of robust sporangia. As noted under *T. floriformis*, specimens which approach these also occur in that species.

Trichia contorta (Ditmar) Rost., Mon. 259. 1875.

Lycogala contortum Ditmar, in Sturm, Deuts. Fl. Pilze 1: 9. 1813.

Perichaena contorta (Ditmar) Fries, Syst. Myc. 3: 192. 1829.

Licea contorta (Ditmar) Wallr., Fl. Crypt. Germ. 2: 345. 1833.

Hemitrichia contorta (Ditmar) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27–28: 75. 1873.

Trichia reniformis Peck, Rep. N. Y. State Mus. 26: 76. 1874.

Trichia inconspicua Rost., Mon. 259. 1875.

Trichia advenula Massee, Jour. Roy. Micr. Soc. 1889: 336. 1889.

Trichia andersonii Rex, Proc. Acad. Phila. 43: 395. 1891.

Trichia iowensis Macbr., Bull. Nat. Hist. Univ. Iowa 2: 133. 1892.

Trichia rostafinskii Čelak. f., Arch. Nat. Land. Böhmen 7(5): 37. 1893.

Trichia pachyderma Čelak. f., Arch. Nat. Land. Böhmen 7(5): 38. 1893.

Trichia intermedia Čelak. f., Arch. Nat. Land. Böhmen 7(5): 38. 1893. Not T. intermedia Massee, 1889.

Sporangia sessile, subglobose on a restricted base, rarely short-stalked, to pulvinate or short-plasmodiocarpous, closely gregarious to scattered on a usually conspicuous white hypothallus, 0.5–0.8 mm wide, dull yellowish brown to dark reddish brown, occasionally blackish; stalk, when present, black; wall membranous or cartilaginous, more or less thickened with granular material or rarely with lime; capillitium ochraceous or dull yellow in mass, the elaters simple or sometimes branched, 3–5 μ in diameter, bearing four or five even or irregular spiral bands, smooth or spiny or with long, spine-like processes formed by spirals freed from the elater, the ends often more or less swollen and tipped with one or two curved spines; spores bright ochraceous in mass, pale yellow by transmitted light, spinulose, 10–13(–14) μ in diameter. Plasmodium watery white.

TYPE LOCALITY: Germany.

HABITAT: Dead wood.

DISTRIBUTION: Europe; temperate North America; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 162, a, b; Hattori, Myxom. Nasu pl. 3, f. 5.

EXSICCATI: Brândză, Myxom. Roum. 111(NY); 60(IA); Thaxter, Rel. Farl. 421.

Distinguished from T. alpina by the usually brown color, although it may be nearly black, the less flattened habit, the smaller spores and the more slender capillitium.

FIG. 101 Plate X Of the various named varieties, some have been raised to species rank and are listed elsewhere. Others are var. inconspicua (Rost.) A. Lister, Mycet. 169. 1894, based on T. inconspicua Rost., for forms with regular spiral bands on the elaters, and var. iowensis (Macbr.) Torr., Broteria 7: 55. 1908, in which the elaters are conspicuously spiny. Both of these merge into the more usual form and probably represent no more than response to particular environmental conditions during maturation. The var. karstenii (Rost.) B. Ing. Trans. Brit. Mycol. Soc. 48: 647. 1965, based on Hemiarcyria karstenii Rost., is here recognized as distinct as Hemitrichia karstenii (Rost.) A. Lister. Trichia mirabilis Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 69: 347. 1966, is also very close, as noted by the author, differing somewhat in the peridial characters and the slightly larger spores.

As treated here, *T. contorta* may prove to include several closely related species but it is not yet possible to separate them on sufficiently constant characters.

Trichia crateriformis Martin, Mycologia 55: 131. 1963.

FIG. 102 Plate X

Trichia craterioides Martin, Brittonia 14: 183. 1962. Not T. craterioides Corda, 1838.

Sporangia stipitate, umber brown, obovate to obconical, flattened above, 0.5–1.5 mm broad, 0.8–1.5 mm tall, sharply divided between a basal cup and an operculum, the cup membranous, more or less furrowed, shining, the operculum flattened, dull; stalk short, usually less than total height of sporangium, mostly one-fourth to one-third the total height; capillitium ample, brownish ochraceous, yellow under lens, the filaments uniformly 7–8 μ in diameter, except at the tips, bearing 4–5 prominent spirals with few or no spines, the tips long-tapering, the filaments often bent in the middle and the two halves spirally twisted about each other; spores globose or ovoid, yellow in mass, pale yellow under lens, verrucose, 11–12 μ in diameter when globose. Plasmodium unknown.

TYPE LOCALITY: Riccarton Bush, South Island, New Zealand.

HABITAT: Dead wood.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATIONS: Brittonia 14: p. 181, f. 2; p. 182, f. 5, 8.

This species is most closely related to *T. botrytis* (J. F. Gmel.) Pers., from which it differs in the wider capillitium threads tapering only near the ends, but chiefly in the sharply distinguished cup and operculum, the former thinner and more iridescent than that of *T. botrytis* and the latter wholly different from the upper portion of that species. The distinct cup and lid and the recurved capillitial threads suggest *Metatrichia vesparium*, from which it differs in color, habit, and, more importantly, in the membranous, rather than cartilaginous cup and lid.

Trichia decipiens (Pers.) Macbr., N. Am. Slime-Moulds 218. 1899.

FIG. 108 Plate XI Lycoperdon pusillum Hedw., Samml. Phys. Naturg. 2: 276. 1780. Not L. pusillum Batsch, 1789.

Arcyria decipiens Pers., Ann. Bot. Usteri 15: 35. 1795.

Trichia fallax Pers., Obs. Myc. 1: 59. 1796.

Trichia virescens Schum., Enum. Pl. Saell. 2: 208. 1803.

Trichia cerina Ditmar, in Sturm, Deuts. Fl. Pilze 1: 51. 1814.

Trichia fulva Purton, Midl. Fl. 3: 290. 1821. Not T. fulva With. 1793.

Trichia furcata Wigand, Jahrb. Wiss. Bot. 3: 30. 1863.

Trichia nana Zukal, Verh. Zool.-Bot. Ges. Wien 35: 334. 1895. Not T. nana Massee, 1889.

Trichia stuhlmannii Eichelb., Verh. Nat. Ver. Hamburg III. 14: 32. 1907.

Trichia pusilla (Hedw.) Martin, N. Am. Flora 1(1): 53. 1949. Not T. pusilla Poir., 1808, nor T. pusilla Schroet., 1885.

Sporangia stalked, rarely sessile, turbinate, 0.6–0.8(–1.3) mm in diameter before dehiscence, shining olive or olivaceous brown, up to 3 mm in total height; peridium firm or membranous, yellow, often translucent when thin, persisting below as a deep or sometimes rather shallow cup; stalk cylindric, furrowed, dark brown below, paler above, usually about 1 mm long, filled with spore-like vesicles; capillitium and spores olivaceous yellow in mass; elaters simple or branched, olivaceous, bearing 3–5 spirals, smooth, 5–6 μ wide in the center, tapering gradually to the long, slender tips; spores pale yellow by transmitted light, bearing a delicate reticulation over most of the surface, the balance minutely warted, 10–13 μ in diameter. Plasmodium white or rose.

TYPE LOCALITY: Germany.

HABITAT: Dead wood.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Samml. Phys. Naturg. 2: unnumb. pl. as L. pusillum; Lister, Mycet. ed. 3. pl. 158, a-d; Macbr. & Mart., Myxom. pl. 19, f. 519, 520; Hattori, Myxom. Nasu pl. 3, f. 1.

EXSICCATI: Ellis & Ev., N. Am. Fungi 3400; Jaap, Myxom. Exs. 96; Hintikka, Myxogast. Fenn. 18; Brândză, Myxom. Roum. 75(NY); 32, 33(IA).

The distinctive characters of this species are the olivaceous color of the spores and capillitium in mass, the often delicate, translucent peridium which may persist below in the form of as nearly regular a cup as in some Arcyrias, and the stalk with spore-like cells within. The reticulation of the spores, often used as a major key character, may be so faint that it can be seen only under an oil immersion objective and in some collections even then with difficulty.

Specimens from the western forests of North America are yellower and more robust than those from other areas, with a membranous, iridescent peridium tending to persist below as a sharply defined, regular cup after dehiscence, approaching *T. floriformis*. It is possible that these should be regarded as specifically distinct although stalk, capillitial and spore characters are as in *T. decipiens*.

"Trichia clavata Wigand," cited by G. Lister, Mycet. ed. 3. 28, as a possible synonym of T. decipiens, was never validly published. Wigand, Jahrb. Wiss. Bot. 3: 28. 1863, cited it as T. clavata Pers.

Trichia erecta Rex, Proc. Acad. Phila. 42: 193. 1890.

Sporangia stalked, scattered or loosely gregarious, sometimes in clusters of two or three, globose or turbinate, 0.5–0.7 mm in diameter, nut-brown, the upper portion often displaying broad, yellow bands arranged in a reticulate pattern, the yellow portion representing the inner peridium, the darker portion the granular thickenings constituting the outer peridium; total height 1–2.6 mm; stalk cylindric, stout, 0.1–1 mm high, 0.2–0.3 mm thick, dark brown, opaque; mass of spores and capillitium bright yellow to orange-yellow; elaters cylindrical, with short tapering ends, 3.5–4 μ in diameter, bearing four spirals marked with short and sometimes scattered spines; spores by transmitted light pale, minutely warted, 11–13 μ in diameter. Plasmodium white.

TYPE LOCALITY: New York. HABITAT: Dead wood.

FIG. 103 Plate X DISTRIBUTION: Quebec and New York to North Carolina, Tennessee, and Kentucky; Washington; Europe; Ceylon; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 158, e-g; Macbr. & Mart., Myxom. pl. 19, f. 514, 515; Hattori, Myxom. Nasu pl. 3, f. 4.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2496; Brândză, Myxom. Roum. III. 2: 29; 78, 110(NY).

The relatively small mottled sporangia borne stiffly on stout, opaque stalks and the spiny capillitium are the marks of this rather rare and distinctive species. The appearance of the sporangia suggests *T. botrytis*, but the yellow bands are broader and more irregular, the stalk is different, the spores larger, and the capillitium entirely distinct.

Trichia favoginea (Batsch) Pers., Neues Mag. Bot. 1: 90. 1794.

Lycoperdon favogineum Batsch, Elench. Fung. Contin. 1: 257. 1786.

Sphaerocarpus chrysospermus Bull., Hist. Champ. Fr. 131. 1791.

Stemonitis favoginea (Batsch) Gmel., Syst. Nat. 2: 1470. 1791.

Trichia chrysosperma (Bull.) Lam. & DC., Fl. Fr. 2: 250. 1805.

Trichia persimilis Karst., Not. Saellsk. Faun. Fl. Fenn. 9: 353. 1868.

Trichia affinis de Bary, in Fuckel, Jahrb. Nass. Ver. Nat. 23-24: 336. 1870.

Trichia jackii Rost., Mon. 258. 1875.

FIG. 104

Plate X

Trichia abrupta Cooke, Ann. Lyc. N. Y. 11: 404. 1877.

Trichia proximella Karst., Bidr. Finl. Nat. Folk 31: 139. 1879.

Trichia balfourii Massee, Jour. Roy. Micr. Soc. 1889: 339. 1889.

Trichia sulphurea Massee, Jour. Roy. Micr. Soc. 1889: 339. 1889.

Trichia intermedia Massee, Jour. Roy. Micr. Soc. 1889: 341. 1889.

Trichia kalbreyeri Massee, Jour. Roy. Micr. Soc. 1889: 344. 1889.

Trichia pulchella Rex, Proc. Acad. Phila. 45: 366. 1893.

Trichia drakeae Lodhi, Indian Slime-Moulds 20: 1934 (as T. drakii).

Sporangia sessile, rarely substipitate, usually crowded but occasionally gregarious or solitary, rarely pseudoaethalioid, 0.5-1 mm in diameter, to 2 mm tall, ranging from irregularly globose, subplasmodiocarpous, or pulvinate to tall-clavate or cylindrical, bright yellow to ochraceous, olivaceous, or yellowbrown, more or less shining or iridescent; dehiscence usually apical, sometimes floriform; peridium membranous, yellow, transparent, nearly smooth or marked with delicate punctate lines; hypothallus membranous, transparent, often with more or less vein-like brown deposits; capillitium yellow, 4-8 μ in diameter, rarely more or less, sometimes with swellings, marked with 3-5 smooth to spiny spiral bands usually connected by longitudinal striations; apices pointed, blunt, or rounded and spiny, or furcate; spores yellow to ochraceous or orange in mass, pale to bright yellow by transmitted light, their markings ranging from a pattern of large, irregularly shaped warts or low, broad, pitted bands forming an irregular or fragmentary network, to a more or less complete reticulation of high, narrow, smooth or minutely pitted ridges (12-)13-15(-16) μ in diameter, including the wide border. Plasmodium watery white or white to yellow.

TYPE LOCALITY: Germany.

HABITAT: Dead wood, rarely on soil or leaves.

DISTRIBUTION: Widely distributed in temperate regions of both hemispheres and in mountains in the tropics.

ILLUSTRATIONS: Lister, Mycet. ed. 3, pl. 159, a, b; Hattori, Myxom. Nasu

pl. 3, f. 3 (as T. favoginea); Lister, Mycet. ed. 3, pl. 160, a-d; Hattori, Myxom. Nasu, pl. 3, f. 2 (as T. affinis); Nat. Geogr. Mag. 49(4): pl. 4 (as T. persimilis); Mycologia 50: 360, f. 1-8; 363, f. 9-15; 365, f. 16-18. EXSICCATI: Ellis, N. Am. Fungi 1112; Brândză, Myxom. Roum. 31(IA), 77, 81(NY), (as T. affinis); Thaxter, Rel. Farl. 422 (as T. favoginea); Jaap, Myxom. Exs. 18, 77; Ellis & Ev., N. Am. Fungi 2100; Sydow, Myc. Germ. 548.

This extremely common and widely distributed species is found everywhere in temperate regions. Within the tropics, it appears to occur only at higher altitudes. Farr (1958) demonstrated that none of the differences supposed to separate T. affinis and T. persimilis from T. favoginea is constant. Her treatment is followed. Her text figures cited show the extraordinary range of variation in the spores and capillitium with complete intergradation in every respect. There is no "T. persimilis Macbr." as cited in Lister, Mycet. ed. 3. 205.

Trichia floriformis (Schw.) G. Lister, Jour. Bot. 57: 110. 1919.

Craterium floriforme Schw., Trans. Am. Phil. Soc. II. 4: 258. 1832.

Trichia lateritia Lév., Ann. Sci. Nat. III. 5: 167. 1846.

Trichia decaisneana de Bary, in Rost., Mon. 250. 1875.

Trichia botrytis var. lateritia (Lév.) G. Lister, Mycet. ed. 2. 217. 1911.

Sporangia stalked, rarely nearly sessile, on a red hypothallus, turbinate or pyriform, 0.6–1 mm in diameter, 1.5 mm in total height, separate or forming clusters with the stalks united, rosy brown or purplish red to nearly black; peridium double, the outer granular layer closely adherent to the inner membranous wall, but often before dehiscence separating above in areolate fashion, the lower portion tending to split into petal-like lobes which remain attached to the stalk; stalk furrowed, irregular, often flattened and repent, clear deep red, translucent when mounted, especially above; spores and capillitium brick red in mass, fading on exposure to brownish orange; elaters simple, rarely branched, bearing 5–6 smooth spirals, 4-6(-8) μ in diameter at the center, tapering gradually to the long, slender tips; spores pale red by transmitted light, very minutely warted, 10-12 μ in diameter. Plasmodium variously reported as white, purple-brown, or black.

TYPE LOCALITY: New York.

HABITAT: Dead wood.

DISTRIBUTION: Maine to Ontario and Washington, south to North Carolina and California; Puerto Rico, Jamaica; Chile; Europe; southern and eastern Asia; Australia, New Zealand.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 163, f. e-i (as T. botrytis); Macbr.
& Mart., Myxom. pl. 20, f. 523; Mycologia 50: 360, f. 1-4; 363, f. 9-14; 365, f. 16-18.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2098 (as T. fragilis f. botrytis); Jaap, Myxom. Exs. 56 (as T. botrytis).

Very close to *T. botrytis*, of which it is sometimes considered a variety, differing in the translucent stem and the orange or red color of the spores and capillitium in mass. Our specimens are mainly from the forests of Washington, Oregon and California. These tend to be more robust than those from eastern North America and Europe, often showing to a remarkable degree the flower-like appearance of

FIG. 105 Plate X the sporangia in dehiscence, while in others there is a very regular cup-like base. It may be that careful study would demonstrate that there is an additional species involved. Similar collections now assigned to *T. botrytis* should be considered in this connection.

Trichia lutescens (A. Lister) A. Lister, Jour. Bot. 35: 216. 1897.

FIG. 106
Plate XI

Oligonema furcatum Buckn., in Massee, Mon. 173. 1892. Not T. furcatum Wig., 1863.

Trichia contorta var. lutescens A. Lister, Mycetozoa 169. 1894.

Hemitrichia karstenii var. lutescens (A. Lister) Torrend, Bull. Soc. Port. Sci. Nat. 2: 61. 1908.

Hemitrichia obrussea Meylan, Bull. Soc. Vaud. Sci. Nat. 52: 449. 1919.

Sporangia sessile, globose or pulvinate, 0.15–0.7 mm in diameter, scattered or in small clusters, shining olivaceous or bright yellow; wall yellow or nearly colorless, membranous, translucent, without granular deposits, usually embossed with the impressions of the spores; capillitium of simple or branched, pale yellow elaters, 3–4.5 μ in diameter, marked with 5–6 close spirals, distinct or sometimes faint, without spines, tapering or blunt and bulbous at the tips; spores bright yellow in mass, pale yellow by transmitted light, closely warted, 10–14 μ in diameter. Plasmodium watery pink.

TYPE LOCALITY: Norway. HABITAT: Dead wood.

DISTRIBUTION: Europe; reported from scattered localities ranging from New York to Virginia, California and Mexico; rarely collected.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 161. c-e. EXSICCATI: Jaap, Myxom. Exs. Nachl. 1: 15; 2: 11.

This species appears to be rare, but may have been overlooked. It has certainly been misunderstood. Of 20 specimens in the Iowa collection referred to T. lutescens, over half certainly belong elsewhere and some of the others are doubtful; all of the latter are scanty. The collection by Meylan from Switzerland appears to be nearly typical and is chosen for illustration. An empty peridium in this specimen is a translucent, yellowish bubble. Other specimens have a somewhat thicker wall. Other species, notably Trichia varia, sometimes have a delicate, translucent peridium, and some of our specimens are examples of such, apparently referred to T. lutescens on the peridial character alone. According to G. Lister, Mycet. ed. 3, 211. 1925, Hemitrichia obrussea Meylan, is a form of this species in which the long elaters are united into a net. A mount from our single very scanty specimen from Meylan shows long, apparently free, elaters. It has the somewhat thicker peridium characteristic of Torrend's specimens from Portugal.

Trichia macbridei M. E. Peck, Am. Jour. Bot. 19: 145. 1932.

FIG. 107 Plate XI Sporangia sessile, closely gregarious or crowded on a strongly developed, dark hypothallus, purplish brown to dark ochraceous, often paler below, depressed-globose, oval or forming short, curved or annular plasmodicarps 0.5–1 mm broad; peridium somewhat iridescent, thin, translucent, but finely granular, breaking irregularly; capillitium and spore-mass ochraceous brown; elaters very long to very short in the same sporangium, simple, uneven, abruptly contracted to the simple or bifurcate tips, marked throughout with a few scattered, blunt spines and warts, the spirals mostly 3–4, imperfectly developed, sometimes broken and replaced for a distance with half-rings; spores densely verrucose,

brown in mass, pale brown by transmitted light, 11–13 μ in diameter. Plasmodium bright pink.

TYPE LOCALITY: Salem, Oregon.

HABITAT: Decaying logs of *Populus*.

DISTRIBUTION: Known only from Oregon.

ILLUSTRATIONS: Am. Jour. Bot. 19: pl. 13, f. 7.

Hagelstein (1944, p. 231) regarded this as a phase of *T. contorta* induced by cold. The original description refers to its relationship with that species, but Peck considered that the pink plasmodium, the relatively large sporangia, the strongly developed hypothallus and the capillitium justified him in describing it as distinct. In this, we concur. Our material lacks any suggestion of representing an irregular development. The spores are not spinulose, as they are in *T. contorta* and as they were originally described for *T. macbridei*, but definitely verrucose. The spines on the elaters are minute, blunt and wart-like, much less conspicuous than indicated in Peck and Gilbert's illustration.

Trichia scabra Rost., Mon. 258. 1875.

Trichia nitens Fries ex Massee, Jour. Roy Micr. Soc. 1889: 333. 1889. Not T. nitens Pers., 1796, nor T. nitens Libert, 1832.

Trichia minima Massee, Jour. Roy. Micr. Soc. 1889: 336. 1889.

Hemiarcyria bucknallii Massee, in Cooke, Grevillea 18: 27. 1889.

Arcyria bucknallii (Massee) Massee, Mon. 161. 1892.

Sporangia sessile, crowded upon a well-developed, dark hypothallus, globose or turbinate, (0.4-)0.5-0.7(-0.8) mm in diameter, dull orange or golden brown; peridium delicate, smooth, shining; capillitial mass deep yellow to rusty orange, the elaters simple, long, 5–6 μ in width, bearing three or four closely wound, regular, spinulose spiral bands, the apices short, acuminate; spores yellow or orange in mass, yellow by transmitted light, the surface marked by a delicate, fine-meshed reticulum, (9-)10-12 μ in diameter. Plasmodium white.

TYPE LOCALITY: Europe.

HABITAT: Rotten wood or bark. DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 159, c-d; Hattori, Myxom. Nasu pl. 4, f. 1.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2100; Sydow, Myc. Germ. 548; Jaap, Myxom. Exs. 18; Brândză, Myxom. Roum. 77(NY); 35(IA).

The characteristic marks of the species are the rather small, usually densely clustered, thin-walled, sessile sporangia, the spinulose, blunt-tipped capillitium, and the finely reticulate spores. The reticulations are easier to see than those of *T. decipiens*, but are scarcely prominent.

Specimens from western North America and from Europe tend to be somewhat larger and more yellow than those from eastern North America but there does not appear to be enough difference in this respect to justify separation.

Trichia subfusca Rex, Proc. Acad. Phila. 42: 192. 1890.

Trichia botrytis var. subfusca (Rex) A. Lister, Mycet. 172. 1894.

Sporangia stalked, rarely nearly sessile, subglobose or somewhat pyriform, scattered or gregarious, occasionally united in pairs, dull tawny brown, without strongly marked lines of dehiscence but with thin areas in wall which suggest

FIG. 109 Plate XI

FIG. 110 Plate XI them, 0.4–0.8 mm in diameter, total height 0.8–1.5 mm; stalk short, stout, dark brown or black, rarely over half the total height; peridium double, the inner hyaline wall closely attached to the outer cartilaginous layer, from which it may become separated; capillitium and spores bright straw-yellow; elaters cylindric, 4–6 μ in diameter, with four rather uneven, smooth spirals, ending in abrupt, often curved tips; spores yellow by transmitted light, minutely roughened, 11–15 μ in diameter. Plasmodium chocolate brown.

TYPE LOCALITY: New York. HABITAT: Dead wood.

DISTRIBUTION: New England to Saskatchewan, south to North Carolina; Washington; Sweden, ?Switzerland; Ceylon, ?West Pakistan, Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 163, l-n; Macbr. & Mart. Myxom. pl. 19, f. 516-518; Hattori, Myxom. Nasu pl. 4, f. 4.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2495.

Closely related to *T. botrytis*, of which it has been regarded as a variety, but differing in color, size, peridium and manner of dehiscence, the short-tipped elaters and the somewhat larger spores. The species seems to be uncommon but may well have been confused with *T. botrytis* and other species.

Trichia varia (Pers.) Pers., Neues Mag. Bot. 1: 90. 1794.

Stemonitis varia Pers., in J. F. Gmel., Syst. Nat. 2: 1470. 1791.

Trichia ovata Pers., Obs. Myc. 1: 61. 1796.

Trichia olivacea Pers., Obs. Myc. 1: 62. 1796.

Trichia cordata Pers., Obs. Myc. 2: 33. 1799.

Trichia cylindrica Pers., Obs. Myc. 2: 33. 1799.

Trichia pyriformis Pers., Obs. Myc. 2: 33. 1799. Not T. pyriformis Hoffm. 1790.

Trichia nigripes Pers., Syn. Fung. 178. 1801.

Trichia aculeata Čelak. f., Arch. Nat. Land. Böhmen 7(5): 34. 1893.

Sporangia gregarious or crowded, globose, obovoid or somewhat elongate, 0.5–0.9 mm broad, sessile or with a short, black stalk, rarely subplasmodio-carpous, ochraceous, yellow-brown, or olivaceous, encrusted, or membranous and then shining; hypothallus broadly expanded, horny, inconspicuous; capillitium of rather long, simple or rarely branched elaters, 3–5 μ in diameter, bearing two or rarely three irregular spiral bands, these prominent and narrow and in places remote, the apices acute, curved, about twice the diameter in length; spores yellow to orange-yellow in mass, dull pale yellow by transmitted light, guttulate, delicately warted, 12–14 μ in diameter. Plasmodium white.

TYPE LOCALITY: Germany.

HABITAT: Dead wood.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 164, a-c; Macbr. & Mart., Myxom. pl. 19, f. 499-501; Hattori, Myxom. Nasu pl. 4, f. 2.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2099; Sydow, Myc. Germ. 549; Jaap, Myxom, Exs. 19, 37, 55, 95, 117; Brândză, Myxom. Roum. I. 1: 25(NY); 57, 58(IA); Thaxter, Rel. Farl. 424.

This species is extremely common in the temperate regions of the world and at higher altitudes in the tropics. As is usual in such cases there is considerable vari-

FIG. 111 Plate XI ation among the various collections in habit, size and branching of elaters and amount of thickening on the peridium. Forms with a delicate, translucent peridium have been rather frequently referred to *T. lutescens*, from which they differ particularly in the character of the elaters. None of the named varieties seems to be more than a similar variant. These include var. *aurata* Meylan, Bull. Soc. Vaud. Sci. Nat. 44: 299. 1908, based on the bright color and the long, sometimes branched, elaters, and the var. *fimicola* Marchal, Bull. Soc. R. Bot. Belg. 34: 128. 1895, with rather narrow elaters and occurring on hare's dung.

Trichia verrucosa Berk., in Hook., f. Fl. Tasm. 2: 269. 1859.

Trichia superba Massee, Jour. Roy. Micr. Soc. 1889: 345. 1889.

Sporangia stalked, rarely sessile, on a membranous hypothallus, pyriform or obovoid, often clustered on a united stem, bright ochraceous, up to 0.8 mm broad and 4 mm tall; wall membranous, translucent, papillose, often somewhat thickened by granular deposits; stalk reddish brown, weak, often flattened or procumbent; spores and capillitium bright ochraceous yellow in mass; elaters long, cylindric, bearing 3–5 spirals, these smooth or bearing a few scattered spines, with short, tapering tips; spores bright yellow by transmitted light, coarsely and prominently reticulate, the bands narrow, minutely pitted and about 1 μ high, the body 10–14 μ in diameter, 12–16 μ including the ridges. Plasmodium white.

TYPE LOCALITY: Tasmania.

HABITAT: Dead wood.

DISTRIBUTION: Tasmania, New South Wales; Great Britain, Portugal; Washington, Oregon; Mexico, Jamaica, Dominica; South America.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 161, a,b; Macbr. & Mart., Myxom. pl. 19, f. 512, 513.

The spores are much like those of *T. favoginea*, although the bands are narrower. From that species it is distinguished by the definitely stalked sporangia, often adhering in clusters. The color, also, is generally brighter. Farr (1958) emphasized the papillose peridium, which is a good character but not easy to see.

EXCLUDED AND DOUBTFUL SPECIES

Trichia alata Trent., in Roth, Cat. Bot. 1: 228. 1797.

Cited by Berlese, Sacc., Syll. 7: 379, as a possible synonym of Didymium macrospermum Rost., now equated with D. squamulosum. G. Lister, Mycet. ed. 3. 47 cites it as a doubtful synonym of Physarum nutans. But Physarum alatum (Trent.) Fries, Syst. Myc. 3: 133. 1829, was based on this species and is cited by G. Lister, 1. c. 118, as a possible synonym of D. squamulosum. The identity of T. alata Trent. must, therefore, remain doubtful.

Trichia alba (Bull.) DC., Fl. Fr. 2: 252. 1802.

A later homonym of *T. alba* With. Based on *Sphaerocarpus albus* Bull., generally accepted as a synonym of *Physarum nutans*.

Trichia alba Purton, Midl. Fl. 3: no. 1113. 1821 (n. v.).

Cited by Rostafinski, Mon. 156. 1874, as synonym of *Didymium microcarpon* (Fr.) Rost., which is probably *D. nigripes*. Possibly not validly published.

"Trichia alba Sow.," Engl. Fungi, pl. 259. 1800.

Not published. Sowerby calls his species T. alba With. Neither his description nor his figure permit identification. Surely not Comatricha nigra, as suggested by later authors; more probably a Didymium.

Trichia alba With., Brit. Pl. ed. 3. 4: 398. 1796 (n. v.).

This appears to be the earliest use of the binomial. Aside from its use by Sowerby, we have found no reference to it.

FIG. 112 Plate XI Trichia angulata Schw., Trans. Am. Phil. Soc. II. 4: 259. 1832. Identity not known.

Trichia antiades (Bull.) DC., Fl. Fr. 2: 252, 1805.

Based on Sphaerocarpus antiades Bull., Hist. Champ. Fr. 127. 1791, pl. 368, f. 2. 1787, as is Physarum antiades (Bull.) Fries, q.v.

Trichia applanata Hedw., in DC., Org. Veg. 2: pl. 60, f. 1. 1827 (n.v.).

Citation based on Berlese, in Sacc., Syll. 7: 442, where it is listed as a synonym of T. varia.

Trichia arcyriaeformis Schum., Enum. Pl. Saell. 2: 206. 1803.

Doubtful. Lister, Mycet. ed. 3: 261.

Trichia asiatica Skvortz., Philip. Jour. Sci. 45: 90. 1931.

Teng & Teng, Sinensia 4: 80. 1933, suggest T. erecta Rex.

Trichia badia Fries, Stirp. Fems. 83. 1825.

Cited by Berlese, in Sacc., Syll. 7: 440, as synonym of T. fallax Pers., i.e., T. decipiens as here recognized. Not cited by Fries in 1829.

Trichia cinerea Trent., in Roth, Cat. Bot. 1: 227. 1797. Not T. cinerea Bull., 1791. Possibly not valid.

Cited by Berlese, in Sacc., Syll. 7: 357, as synonym of Craterium leucoce-phalum.

Trichia citrina Schum., Enum. Pl. Saell. 2: 209. 1803.

Both Berlese and Lister suggest T. clavata.

Trichia clavata Wigand, Jahrb. Wiss. Bot. 3: 28. 1863.

Not validly published. Wigand cites Persoon.

Trichia coccinea (Bull.) DC., Fl. Fr. 2: 255. 1805.

Based on Sphaerocarpus coccineus Bull. Doubtful.

Trichia coccinea Poir., in Lam. Encycl. 8: 55. 1808.

Cited by G. Lister, Mycet. ed. 3: 179, as possible synonym of *Dictydium cancellatum*. If this is intended to be the same as the preceding, that is more than doubtful.

Trichia crassa Schum., Enum. Pl. Saell. 2: 208. 1803.

Doubtful. G. Lister, Mycet. ed. 3: 261.

Trichia craterioides Corda, Icones 2: 21. 1838. Not T. craterioides Martin, 1962. Cited by G. Lister, Mycet. ed. 2. 212, as a definite synonym of T. varia, possibly because Corda's figure shows 2–3 spirals on the elaters. In other respects it does not fit that species satisfactorily and its identity must remain uncertain, pending examination of Corda's material if it is still in existence.

Trichia crenulata (Meylan) Meylan, Bull. Soc. Vaud. Sci. Nat. 57: 47. 1929.

Based on T. contorta var. crenulata Meylan, Bull. Soc. Vaud. Sci. Nat. 55: 244. 1924. With crenulate spores. Quite probably worthy of recognition.

Trichia depressa Trent., in Roth, Cat. Bot. 1: 231. 1797.

Cited by Fries, Syst. Myc. 3: 119, as synonym of *Didymium farinaceum*, citing p. 229 of Roth; by G. Lister, Mycet. ed. 3, as page above. Possibly a mistake for *T. compressa*?

Trichia difformis Schw., Trans. Am. Phil. Soc. II. 4: 259. 1832.

Not recognizable from description.

Trichia erythropus Borszczow, Fung. ingrici. 1856.

Listed by Rost., Mon. 265, without citation, as a synonym of *Hemiarcyria clavata* (p.p. in index).

Trichia expansa Martius, K. Baier. Akad. Wiss. 1853: 224. 1853.

Hemiarcyria expansa (Martius) Sacc. & Sacc., Syll. Fung. 18: 212. 1906.

Cited by G. Lister, Mycet. ed. 3. 230, as doubtful synonym of Arcyria ferruginea. The description given in Saccardo makes this highly unlikely.

Trichia faginea Johnston, Fl. Berwick 2: 191. 1831.

Not a myxomycete. According to D. P. Rogers, in litt., what is now called Solenia anomala.

Trichia favoginea Schum., Enum. Pl. Saell. 2: 207. 1803.

Cited by Berlese, in Sacc., Syll. 7: 442 as synonym of *T. varia*. It is not certain that Schumacher intended this to be a new name. If so, it is a later homonym of *T. favoginea* (Batsch) Pers., 1794.

Trichia filamentosa Trent., in Roth, Cat. Bot. 1: 227. 1797.

Cited by G. Lister, Mycet. ed. 3. 47, as synonym of *Physarum nutans* var. leucophaeum.

Trichia fulva With., Brit. Pl., ed. 2. 4: 479. 1792.

Cited by G. Lister, Mycet. ed. 3. 230, as a possible synonym of Arcyria ferruginea.

Trichia furfuracea With., Brit. Pl. ed. 2. 3: 392. 1792.

Doubtful. G. Lister, Mycet. ed. 3. 261.

Trichia globosa Vill., Fl. Dauph. 1061. 1799.

Cited by G. Lister, Mycet. ed. 3. 115, as synonym of Didymium melano-spermum.

Trichia hemisphaerica Trent., in Roth, Cat. Bot. 1: 228. 1797.

Cited by G. Lister, Mycet. ed. 3. 47 (as T. hemispheria), as possible synonym of Physarum nutans. Rost., Mon. 157. 1874, cited it as a synonym of Didymium microcarpon (Fries) Rost. (p.p. in index).

Trichia heterotricha Balf. f., in Cooke, Grevillea 10: 117. 1882.

Regarded by G. Lister, Mycet. ed. 3. 209, as an incompletely developed form of her *T. contorta* complex.

Trichia lenticularis Hoffm., Veg. Crypt. 2: 16. 1790.

Doubtful. G. Lister, Mycet. ed. 3. 261.

Trichia lichenoides Sibth., Fl. Oxon. 405. 1794.

Possibly a lichen. G. Lister, Mycet. ed. 3. 261.

Trichia miniata Schw., Trans. Am. Phil. Soc. II. 4: 259. 1832.

Description suggests a phase of Metatrichia vesparium.

Trichia munda (A. Lister) Meylan, Bull. Soc. Vaud. Sci. Nat. 57: 46. 1929.

Based on *Trichia botrytis* var. munda A. Lister, Jour. Bot. 35: 216. 1897. Above is evidently not Meylan's original publication, but earlier use of the combination has not been located.

Trichia nivea Müll., Fl. Dan. 5(13): 8, pl. 776, f. 2. 1782.

Cited by Rostafinski, Mon. 94. 1874, as possible synonym of *Physarum affine* Rost.

Trichia obtusa Wigand, Jahrb. Wiss. Bot. 3: 30. 1863.

Included by G. Lister, Mycet. ed. 3, 221, in Hemitrichia clavata complex.

Trichia olivacea With., Brit. Pl. ed. 3. 4: 392. 1796.

Doubtful. G. Lister, Mycet. ed. 3. 261.

Trichia operculata Brühl & Gupta, Jour. Dept. Sci. Univ. Calcutta 8: 119. 1927 (n.v.)

Trichia ovalispora Hollos, Math. Nat. Wiss. Bull. Ung. 20: 324. 1905.

Cited by G. Lister, Mycet. ed. 3. 209, as possible synonym of T. contorta.

Trichia pedicellata Poir., in Lam. Encycl. Supp. 5: 373. 1817.

Cited by G. Lister, Mycet. ed. 3. 117, as definitive synonym of *Didymium squamulosum*.

Trichia physaroides Schum., Enum. Pl. Saell. 2: 210. 1803.

Doubtful. G. Lister, Mycet. ed. 3. 262.

Trichia piriformis Hoffm., Veg. Crypt. 2: 1. 1790.

Also cited as *T. pyriformis*, in Fries, Syst. Myc. 3: 184. 1829, and elsewhere. Used by various authors, including Sibthorp, 1784 and Villars, 1786–9, for various Trichias. Hoffman's name may have applied to *Hemitrichia vesparium*.

Trichia polymorpha Sow., Engl. Fungi, pl. 180. 1799.

Cited by G. Lister, Mycet. ed. 3. 230 as synonym of Arcyria ferruginea. Sowerby's plate and accompanying "description" do not permit identification. Perhaps an Arcyria, but surely not A. ferruginea.

Trichia purpurea Schum., Enum. Pl. Saell. 2: 211. 1803.

Cited by G. Lister, Mycet. ed. 3, as doubtful synonym of Arcyria denudata.

Trichia ramulosa Rudolfi, Linnaea 4: 119. 1829.

Basionym of Arcyria ramulosa (Rudolfi) Wigand, Jahrb. Wiss. Bot. 3: 43. 1863. Wigand speaks of the capillitium as completely smooth, and this is shown in his illustration, pl. 3, f. 17. The original description, as quoted, does not apply to either Trichia or Arcyria. The species was reported from Peru and may represent a new genus.

Trichia recutita With., Brit. Pl. ed. 2. 3: 392. 1793.

Cited by G. Lister, Mycet. ed. 3. 362 as doubtful. We have not seen the original publication. Berlese, in Sacc., Syll. 7, indexes it, but on the page indicated, 444, *T. reticulata* Grev. is the only *Trichia* with a comparable name cited. It is not cited elsewhere, so far as we have noted, and may be an error. Greville, Scot. Crypt. Fl. pl. 266. 1826, cites *T. reticulata* Pers.

Trichia reticulata DC., Fl. Fr. 2: 256. 1805. Not T. reticulata Pers., 1797.

Possibly Dictydium cancellatum. Lister, Mycet. ed. 2. 262.

Trichia rufa Hoffm., Veg. Crypt. 2: 10. 1833. Probably not T. rufa With., 1792. Doubtful. G. Lister, Mycet. ed. 3. 262.

Trichia semicancellata DC., Fl. Fr. 2: 255. 1805.

Probably a Cribraria.

Trichia sphaerocephala Hoffm., Veg. Crypt. 2: 15. 1790.

Doubtful. G. Lister, Mycet. ed. 3. 262.

Trichia thwaitsii Berk. & Br., Jour. Linn. Soc. 14: 86. 1873.

Included by Berlese, in Sacc., Syll. 7: 447, in the Hemiarcyria clavata complex.

Trichia turbinata (Bolt.) With., Brit. Pl. ed. 3. 4: 480. 1796.

Cited by G. Lister, Mycet. ed. 2. 207 as possible synonym of *T. favoginea*, in ed. 3. 208, of *T. varia*. In both cases the combination is attributed to Sowerby. But Sowerby specifically adopts Withering's name for the species he illustrates in his *pl.* 85. 1797. "Clathrus turbinatus Huds.," also cited, is a shortening of a polynomial and is invalid, but the combination was validated by the publication of Clathrus turbinatus Bolton, Hist. Fungi 3: 94. 1789. The name appears in numerous publications but it is impossible to say more than that it is a sessile *Trichia*.

Trichia venosa Poir., in Lam. Encyc. 8: 55. 1808. Not T. venosa Schum., Enum. Pl. Saell. 20: 5. 1803.

Cited by Berlese, in Sacc., Syll. 7: 411, as synonym of *Dictydium venosum* Schrad., q.v., on which it may have been based.

Trichia vulgaris Pers., Obs. Myc. 2: 32. 1796.

Cited by G. Lister, Mycet. ed. 3. 208, as a possible synonym of T. varia.

STEMONITALES

Macbride, N. Am. Slime-Moulds, ed. 2. 122. 1922.

Spores in mass varying from black or deep violaceous to ferruginous, always distinctly colored by transmitted light; neither peridium nor capillitium calcareous; lime, when present, restricted to hypothallus and base of sporangium except in *Diachea*, where it is conspicuously present in the stalk and columella; capillitium thread-like, often reticulate, usually dark.

With a single family.

Neither the Amaurochaetaceae nor the Lamprodermataceae seem to be sufficiently distinct from the Stemonitaceae and, as Nannenga-Bremekamp (1967) has pointed out, the Collodermataceae is equally superfluous. In the same paper, however, Nannenga-Bremekamp proposes the family Schenellaceae for the single genus Schenella. This may have merit, but since each of the two species of that genus is known from but a single collection, there need be no haste to recognize the family.

Stemonitaceae

Rost., Versuch. 6. 1873 (as tribus).

Sporangiate to aethalioid; peridium membranous, persistent or fugacious, in one genus gelatinous; columella usually present in elongate sporangia; capillitium thread-like, branching and usually anastomosing, arising from the columella, from the base of the sporangium or aethalium or sometimes, in part, from the peridium; hypothallus membranous, sometimes common to a group of sporangia; spores black, purplish-brown, yellow-brown or ferruginous in mass.

Nannenga-Bremekamp (1967) and Ing and Nannenga-Bremekamp (1967) have recently proposed radical emendation of the Stemonitaceae. Their papers were received too late to permit extended study of their suggested alterations but the proposed changes are noted in appropriate places in the text and their careful consideration is recommended to interested students. Two new genera have been proposed: Collaria Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 70: 208. 1967, which includes Comatricha rubens A. Lister (Type), C. lurida A. Lister, and Lamproderma arcyrionema Rost., and Symphytocarpus B. Ing & Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 70: 218. 1967, based on Comatricha flaccida (A. Lister) Morgan and including species formerly referred to Stemonitis, together with several additional taxa, here listed briefly at the end of that genus.

KEY TO GENERA

a. Fructification an aethalium.

b

a. Fructification sporangiate, the sporangia scattered, clustered or sometimes massed into a pseudoaethalium.

c

 Capillitium a network of more or less horizontal, branching threads, the tips of the branches united by many chambered vesicles.

Brefeldia

 Capillitium dendroid, the main stalks arising from the base, the tips of the branches free.

Amaurochaete

 Wax present in stalk and columella, sometimes in capillitium and sporangial wall.

Elaeomyxa

c.	Wax not secreted.	d
	d. Columella, stalk when present, and	
	usually hypothallus conspicuously limy.	Diachea
	d. Lime lacking, or rarely present as inconspicuous	
	clusters of crystals imbedded in base or hypothallus.	e
e.	Columella usually lacking; rarely present in some sessile forms.	f
e.	Columella always present.	j
	f. Fructification a pseudoaethalium; sporangia closely	
	packed, the peridium fugacious except for conical	
	base and cap; capillitium of sparsely branched	
	threads coiled as a mass and united in basal cups and	C 1 11
	apical caps, the whole covered by a continuous membran	e. Schenella
	f. Fructification sporangiate, sporangia free or clustered,	
	sometimes united into pseudoaethalium, but capillitium	ď
	then not in coiled spirals united in basal and apical cups.	g
g.	Sporangia sessile on a broad or constricted base	h
~	which is rarely contracted into a short, thick stalk. Sporangia mostly stalked, rarely sessile and then with	11
g.	a distinct columella from which the capillitium arises.	i
	h. Outer wall of peridium gelatinous when wet.	Colloderm
	h. Outer wall of peridium not gelatinous when wet.	i
i.	Peridium membranous above, thickened with	_
	granular deposits below and usually including scale-like	
	masses of lime crystals in lower part and hypothallus.	Leptoderma
i.	Peridium membranous, hyaline,	-
	iridescent throughout; lime crystals lacking.	Diacheopsis
	j. Columella enlarged at apex into a	
	cupulate disk from which the capillitium depends.	Enerthenema
	j. Columella sometimes attaining apex, usually	
	shorter, and not bearing a cupulate	
	apical disk; capillitium usually arising	_
	from entire columella or from base of sporangium.	k
k.	Peridium evanescent, but typically replaced by a	
	surface net developed under the periphery, remaining after	a. 4.4
	the peridium has been shed, and united with the capillitium.	Stemonitis
k.	Peridium persistent or, if evanescent, without surface	
	net; capillitium often scanty, sometimes abundant but then	1
	without surface net and usually with many terminal branchlets	s. I
	l. Peridium ochraceous, delicate, persistent, but	
	breaking up into small, scale-like fragments which remain attached to tips of capillitial branchlets.	Clastoderma
	l. Peridium not breaking up into small	Ciastouerina
	fragments which remain attached to tips of capillitium.	m
m.	Peridium dark, tough, persistent, early splitting above	***
	into petaloid lobes which remain attached at base as a cup.	Barbeyella
m.	Peridium not splitting into petaloid lobes arising from a basal	
	n. Stalk typically translucent,	•
	hollow, often yellow at base.	Macbrideola
	n. Stalk dark, opaque, not hollow.	o
о.	Peridium tough, metallic, shining,	
	tending to be long-persistent as a whole.	Lamproderma
o.	Peridium usually early evanescent	
	or, if persistent, membranous, delicate.	Comatricha

Brefeldia

Rost., Versuch. 8. 1873.

Fructification an aethalium, large, pulvinate, with a continuous cortex, arising from a broadly expanded hypothallus, broken up internally by irregular

walls and numerous flattened, columella-like projections, the latter giving rise to the thread-like, netted capillitium, which bears inflated, multicellular vesicles at the nodes; spores black in mass.

Type species, Reticularia maxima Fries.

A single species.

Brefeldia maxima (Fries) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27-28: 70. 1873.

Reticularia maxima Fries, Syst. Orbis Veg. 147. 1825.

Licea perreptans Berk., Gard. Chron. 1848: 451. 1848.

FIG. 124 Plate XIII

Aethalium large, (2–)4–30 cm in its longest dimension, 5–15 mm thick, borne upon a widespread, silvery, shining hypothallus, purplish black, the peridium at first papillate, soon fugacious; capillitium abundant, the threads dark, netted, the nodes bearing multicellular vesicles, the whole borne upon, but often breaking away from the flattened and irregular, columellate basal strands; spores brownish black or fuscous in mass, yellow-brown by transmitted light, distinctly warted, 9–12 μ in diameter. Plasmodium white.

TYPE LOCALITY: Europe.

HABITAT: Dead wood and surface litter.

DISTRIBUTION: Europe; northern United States and Canada, across the continent; Argentina.

ILLUSTRATIONS: Macbr., N. Am. Slime-Moulds ed. 1, frontispiece, pl. 5, f. 7, 7a, 7b; ed. 2. pl. 21, 22; Lister, Mycet. ed. 3. pl. 136, d-g; Macbr. & Mart., Myxom. pl. 11, f. 244, 245.

EXSICCATI: Jaap, Myxom. Exs. 33, 50; Roum., Fungi Sel. 6707; Brândză, Myxom. Roum. I. 1: 21(NY).

Although many collections are of moderate size, this species may be one of the largest of the slime molds. The suggestion of the basic presence of numerous sporangia is very apparent in some collections, and the numerous columella-like stalks arising from the base of the aethalium further suggest this. The characteristic vesicular structures may arise at the junction of the consistent sporangia somewhat as do the peridial disks in *Stemonitis confluens*. Nevertheless the picture is that of a true aethalium.

Dermodium inquinans Link, Ges. Natur. Freunde Mag. 3: 25. 1809. (as Demordium) may have referred to this species or to an Amaurochaete. There is no "D. inquinans Fries." See Martin, (1966).

The species appears to be uncommon in North America but more common in Europe.

Amaurochaete

Rost., Versuch 8. 1873.

Matruchotia Skup., Bull. Acad. Pol. 1924: 396. 1924. Not Matruchotia Boul. 1893.

Matruchotiella Skup., ex. G. Lister, Mycet. ed. 3, 165. 1925. Not Matruchotiella Grigorakis.

Fructification aethalioid, depressed-pulvinate; peridium evanescent, leaving after its disappearance a mass of irregular stalks and branches seated on a common, dark, membranous hypothallus; spores black or brown.

Type species, Reticularia atra (Alb. & Schw.) Fries.

The suggestion that the fructifications are composed of densely massed and agglutinated sporangia is very strong in some collections, which is the reason certain species have been regarded as representing aberrant fruitings of Stemonitis. That is particularly true of A. ferruginea, q.v. However, the complete lack of a surface net in all specimens examined and the dendroid character of the erect pillars regarded as columellae in such species makes this extremely doubtful, especially when the spore characters are compared with the species of Stemonitis to which they are referred. It is more likely that some of the fruitings might be regarded as pseudoaethalia rather than aethalia, but only careful study of younger stages than are available, and particularly of developmental stages, could clarify this point.

KEY TO SPECIES

Capillitium and spores fuscous to bone brown in mass; spores pale, 7.5-10 μ.
 A. ferruginea

a. Capillitium and spores black in mass; spores dark, usually 11 μ or more.

Capillitium soft, woolly, circinate.

b. Capillitium rigid, irregular.

Capillitium entirely of slender threads, attached at top and bottom; spores prominently warted.

A. comata

 Capillitium arising from stout basal stalks, branching and anastomosing toward slender upper threads; spores minutely roughened.

threads; spores minutely roughened.

A. tubulina varted or spinulose.

A. atra

d. Spores warted or spinulose.d. Spores strongly reticulate.

A. trechispora

b

d

Amaurochaete atra (Alb. & Schw.) Rost., Mon. 211. 1874.

PLycoperdon fuliginosum Sow., Engl. Fungi, pl. 257. 1800.

Lycogala atrum Alb. & Schw., Consp. Fung. 83. 1805.

Strongylium atrum (Alb. & Schw.) Sw., Sv. Veg.-Akad. Handl. 36: 110. 1815.

Strongylium majus Fries, Symb. Gast. 9. 1817.

Reticularia strongylium Schw., Schr. Nat. Ges. Leipzig 1: 35. 1822.

Reticularia atra (Alb. & Schw.) Fries, Syst. Myc. 3: 86. 1829.

Amaurochaete fuliginosa (Sow.) Macbr., N. Am. Slime-Moulds 109. 1899.

Aethalium pulvinate to subglobose, attaining 8 cm in extent; cortex at first shining, then dull black, fragile, early dissipated; hypothallus expanded, glossy purplish black; capillitium irregular, rigid, with or without columellae, anastomosing and netted near but not at the surface; spores black in mass, purplish by transmitted light, irregularly globose, spinulose, (10–)12–15 μ in diameter. Plasmodium creamy white.

TYPE LOCALITY: England.

HABITAT: Coniferous wood.

DISTRIBUTION: Widely distributed in Europe; New England and Ontario to Florida, Colorado and Washington; Japan.

ILLUSTRATIONS: Alb. & Schw., Consp. Fung. pl. 3, f. 3; Lister, Mycet. ed. 3. pl. 136, a-c.

EXSICCATI: Brândză, Myxom. Roum. 97(NY).

Readily recognized by the coarse, rigid, usually dendroid capillitial units arising from the base, and the dark, spinulose spores.

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FIG. 127 Plate XIII Fries cites Lycoperdon fuliginosum Sow. as a synonym of his Reticularia atra and Sowerby's epithet was combined as Amaurochaete fuliginosa (Sow.) Macbr., N. Am. Slime-Moulds 109. 1899. This name was accepted by G. Lister, Mycet. ed. 2. 171. 1911, and has been widely used since then. Sowerby's description is extremely vague and his figure unconvincing. There is little doubt that Lycogala atrum Alb. & Schw., var. α , and probably var. β as well, applies to this species, and Rostafinski's combination is therefore adopted.

Amaurochaete comata G. Lister & Brândză, Jour. Bot. 64: 225. 1926.

Aethalia scattered, pulvinate, black, glossy, 5–10 mm in diameter, possibly much larger, seated on a shining membranous hypothallus; columellae lacking; capillitium of flexuous, branching, sparsely anastomosing, black threads, 1–2 μ in diameter, occasionally larger at intervals, 3 μ or more, and bearing spiny free ends, arising from base and attached to the peridium; spores black in mass, dark purplish gray under the lens, closely warted, somewhat paler and less strongly warted on one side, (11–)13–14(–14.5) μ in diameter.

FIG. 125 Plate XIII

TYPE LOCALITY: Neamtz, Rumania.

HABITAT: Trunks and branches of living Abies.

DISTRIBUTION: Known only from the type locality, where it is said to be not infrequent.

ILLUSTRATION: Jour. Bot. 64, pl. 576.

EXSICCATI: Brândză, Myxom. Roum. 95(IA).

Lister's illustration shows three aethalia, one of which would be 25 mm across, if the magnification given is correct, and all three are surrounded by a conspicuous white hypothallus. The magnification may not be correct, however, since that of the spores is given as \times 230, which would make them 26 μ in diameter.

It is not possible to decide on the size of the aethalia from Brândza's No. 95, which is the only specimen available to us, but it is possible that some may have been much more than 10 mm across, perhaps 25 or 30. The spore size is given as $11-12 \mu$ in the original description. Those in the material we have are mostly $13-14 \mu$, with some approaching 15μ .

Amaurochaete ferruginea Macbr. & Martin., Jour. Wash. Acad. 22: 89. 1932.

Aethalium pulvinate, flat, attaining 7 cm in length and 4 cm in width; cortex fugacious; hypothallus shining, silvery at the margin where it extends beyond the border of the aethalium; capillitium arising from numerous rigid, irregular branches arising from the hypothallus, the threads dark brown, bearing numerous lighter brown, irregular, membranous expansions; spores bone-brown, cinnamon-drab, or benzo-brown in mass, pale reddish brown by transmitted light, minutely warted. 8–10 μ in diameter. Plasmodium white.

FIG. 126 Plate XIII

TYPE LOCALITY: Yosemite, California.

HABITAT: Coniferous wood and on grass and litter.

DISTRIBUTION: New York, Ontario, Louisiana, Colorado, Washington, Oregon, California; Pakistan.

Hagelstein (1944) included this in Stemonitis splendens Rost. var. flaccida A. Lister. Nannenga-Bremekamp (1961) called it Comatricha flaccida (A. Lister) Morgan, here cited as a synonym of Stemonitis splendens. More recently, Ing and Nannenga-Bremekamp (1967), after examining the type of Stemonitis splendens var. flaccida in the British Museum and comparing it with a portion of the type

of A. ferruginosa have decided that they are the same and have included both in their new combination Symphytocarpus flaccidus (Morgan) B. Ing & Nann.-Brem. Among our specimens of Comatricha flaccida (A. Lister) Morgan, there is one certainly, and another probably, collected and determined by Morgan. Neither suggests A. ferruginea, but both would fit C. flaccida as described. In view of the uncertainty, we feel justified in retaining the species in Amaurochaete.

FIG. 128 Plate XIII Aethalium pulvinate, flat, attaining 7 cm in length; cortex dark, shining, faintly tuberculate; hypothallus broadly expanded, persistent, extending well beyond the border of the aethalium, somewhat silvery, with yellowish stains; capillitium black, rigid, irregular, arising from numerous columella-like bases, branching and anastomosing irregularly; spores purplish black in mass, lilaceous brown by transmitted light, strongly reticulate, the bands narrow, dark and

Amaurochaete trechispora Macbr. & Martin, Jour. Wash. Acad. 22: 89. 1932.

about 2 μ high, 13–15 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Temagami, Ontario. HABITAT: On Sphagnum and leaves.

DISTRIBUTION: Ontario; Massachusetts.

ILLUSTRATIONS: Macbr. & Martin, Myxom. pl. 11, f. 239, 240; Jour. Wash.

Acad. 22: 90, f. 4, 5.

Hagelstein (1944) regarded this as a phase of Stemonitis trechispora (Torrend) Macbr. responding to wet conditions. The spores are much larger and darker and much more strongly reticulate than in any collection of S. trechispora we have examined, and the capillitium is entirely different, quite aside from the aethalioid habit.

Amaurochaete tubulina (Alb. & Schw.) Macbr., N. Am. Slime-Moulds ed. 2. 150. 1922.

FIG. 129

Plate XIII

Stemonitis tubulina Alb. & Schw., Consp. Fung. 102. 1805.

Lachnobolus cribrosus Fries, Syst. Orbis Veg. 148. 1825.

Amaurochaete cribrosa (Fries) Macbride, in Sturgis, Mycologia 9: 328. 1917.

Matruchotia splendida Skup., Bull. Acad. Pol. 1924: 396. 1924.

Matruchotiella splendida (Skup.) Skup. ex. G. Lister, Mycet. ed. 3. 165. 1925.

Aethalium pulvinate, flattened, attaining 10 cm in length; cortex thin, transparent, papillate, fragile, evanescent; hypothallus thin, glossy, long-persistent, dull black; capillitium dendroid, arising from irregular stout basal portions, which branch and anastomose freely into smaller threads above; spores black in mass, dull olivaceous under the lens, minutely roughened, 12–15 μ in diameter. Plasmodium at first hyaline, then rosy or ashen, finally black.

TYPE LOCALITY: Germany.

HABITAT: Coniferous wood.

DISTRIBUTION: Great Britain, Norway, central Europe; Massachusetts, Pennsylvania, Washington, Oregon, California; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 217, a-c.

EXSICCATI: Thaxter, Rel. Farl. 372 (as Amaurochaete atra).

Both G. Lister (1925) and Hagelstein (1944) used Macbride's name, based on Lachnobolus cribrosus Fries. Macbride discussed that at length, (1922, pp. 151-

153) and his usage is followed. Our specimens are from Massachusetts and Washington. According to Macbride, the species is common on newly felled, decorticate pine logs in the Pacific northwest.

Iundzillia tubulina (Alb. & Schw.) Racib., Hedwigia 26: 111. 1887, based on Stemonitis tubulina Alb. & Schw., should belong here. Čelakovsky, Arch. Nat. Land. Böhmen 7(5): 46. 1893, accepted Raciborski's genus and species, spelling the genus Jundzillia. In the second and third editions of the Lister monograph (1911, 1925) G. Lister enters it, as Jundzilla, as a synonym of Stemonitis splendens var. flaccida. As noted under Amaurochaete ferruginea, specimens so labelled seem to be referable to that species, hence the application of Raciborski's name remains doubtful.

DOUBTFUL SPECIES

Amaurochaete speciosa Zukal, Ver. Zool.-Bot. Ges. Wien 35: 335. 1885.

Cited by Berlese in Sacc. 7: 399, as a synonym of A. tubulina; by A. Lister, Mycet. 110. 1894, and by G. Lister in eds. 2 and 3 of the same, as a definite synonym of Stemonitis fusca var. confluens A. Lister.

Elaeomyxa

Hagelst., Mycologia 34: 593. 1942.

Sporangiate, stalked or sessile, limeless; peridium membranous; capillitium composed of branching and anastomosing purplish threads; oil or wax present in the stalk, the columella, the sporangial wall, or the capillitium in the form of granules, globules, or inclusions.

The wax in the stalk and wall is clearly seen only when the specimens are wet or mounted. That in the capillitium of *E. miyazakiensis* is in the form of swellings, often nodular, on the threads.

Type species, Diachea miyazakiensis Emoto.

Hagelstein believed that the genus was sufficiently distinct to justify its segregation in a separate family. This may prove to be desirable, but in view of the scanty material available and the apparent irregularity in the published descriptions, it seems better to defer recognition of another monogeneric family until its necessity is more clearly demonstrated.

KEY TO SPECIES

a. Wax secreted only in stalk, and collar when present; spores dark, over 10 μ .

E. cerifera

a. Wax secreted in stalk, capillitium and sporangial wall; spores pale, $7-10 \mu$.

E. miyazakiensis

Elaeomyxa cerifera (G. Lister) Hagelst., Mycologia 34: 593. 1942.

Lamproderma columbinum var. sessile G. Lister, Mycet. ed. 2. 165. 1911.

Diachea cerifera G. Lister, Jour. Bot. 51: 3. 1913.

Diacheopsis cerifera (G. Lister) Meylan, Bull. Soc. Vaud. Sci. Nat. 58: 82. 1933.

Sporangiate, stalked or sessile, scattered or in small clusters; sporangia subglobose or ovoid, 0.7–1.2 mm in diameter, brownish purple, iridescent, total height 0.7–1.8 mm; peridium membranous, hyaline, yellowish or dusky, persistent below; stalk when present, pale, becoming yellowish brown or black, 0.2–0.6 mm high, 0.15–0.5 mm thick, containing waxy inclusions, when black,

FIG. 130 Plate XIII sometimes with a thick, yellow, waxy collar at the apex; columella none, or represented by the thick convex apex of the stalk which also serves as the base of the sporangium and from which the capillitium arises; capillitium rigid, the threads dark purplish, with pale tips; spores black in mass, dark gray by transmitted light, minutely spinulose, $10-13(-19)^{\circ}$ μ in diameter. Plasmodium white.

TYPE LOCALITY: Norway.

HABITAT: On mosses and liverworts.

DISTRIBUTION: England, Norway, Switzerland, Rumania; Japan. ILLUSTRATIONS: Jour. Bot. 51: 3, f. 525; Lister, Mycet. ed. 3. pl. 212.

The waxy collar is found only in Japanese collections, which led Hagelstein to suggest that perhaps two species are included here. The wide range in published spore size is also suggestive of the same thing. G. Lister (1911) suggested that the very large spores reported represented incomplete development. She cited Physarum iridescens Berk. \equiv Lamproderma iridescens (Berk.) Rost., as a synonym of L. columbinum var. sessile, but in Mycet. ed. 3. 155, she included the latter in the synonymy of L. columbinum var. iridescens (Berk.) G. Lister, where they are cited in the present treatment. It may be they belong here.

The species has not yet been collected in the western hemisphere.

Elaeomyxa miyazakiensis (Emoto) Hagelst., Mycologia 34: 593. 1942.

Diachea miyazakiensis Emoto, Proc. Acad. Japan 11: 444. 1935.

Sporangia gregarious, stalked, ovate or subcylindric, blue or violet, iridescent, their total height 1–1.5 mm; stalk cylindric or slightly swollen in the middle, brownish black, 0.1–1 mm long, 0.2–0.3 mm thick; columella limeless, about half the height of the sporangium; capillitium arising from the columella, composed of dark, purplish brown, branching and anastomosing threads, colorless at the tips and bearing in the axils nodules of pale orange or red, granular wax; spores dark violet-brown in mass, clear violet by transmitted light, warted, 7–10 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Japan. HABITAT: Dead wood.

DISTRIBUTION: Japan; Ontario.

ILLUSTRATION: Proc. Acad. Japan 11: 444, f. 1-3.

Distinguished from *E. cerifera* by the wax in the peridium, the waxy nodes, and the smaller and paler spores. Apparently very rare.

Diachea

FIG. 131 Plate XIII

Fries, Syst. Orbis Veg. 143. 1825.

Diachaeella Höhnel, Sitz.-ber. Akad. Wien 118: 436. 1909.

Sporangia globose or cylindric, stipitate or sessile; peridium simple, thin, iridescent, tending to be persistent; columella, and stipe when present, calcareous, rigid, thick, tapering upward; capillitium limeless, of delicate threads united into a net, the tips attached to the peridium; spores black or dark purple in mass. *Diachaea* is an alternative spelling.

Type species, Stemonitis elegans Trentep.

In his original publication, Fries assigned *Diachea* to his Trichiacei, between *Arcyria* and *Stemonitis*. In Syst. Mycol. 3. 1828, he transferred it to the Stemo-

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nitei. Rostafinski (1874) placed it in his Spumariaceae, next to Spumaria (Mucilago) and in this association with the limy Physarales he was followed in Massee, in the various editions of the Lister monograph and by Hagelstein. Morgan (1894) replaced it in the Stemonitaceae with the very pertinent remark, "This genus is scarcely to be distinguished from Lamproderma, except by the white mass of lime which fills the tube of the stipe and columella." He was followed by Macbride (1899, 1922), Macbride and Martin (1934) and Martin (1949).

In the 3rd edition of the Lister monograph (1925) three limeless species, D. cerifera, D. cylindrica and D. caespitosa, are included in the genus. Hagelstein transferred D. cerifera to Elaeomyxa but retained the other two species in Diachea. Both are here regarded as better placed in Comatricha, but Lister's treatment emphasizes the close relationship of Diachea to both Lamproderma and Comatricha.

In establishing the genus *Diachaeella*, based on *Didymium bulbillosum* Berk. & Br., von Höhnel stressed the large, crystalline lime nodules in the stalk and columella. These, however, are very variable (see under *Diachea bulbillosa*) and also occur in other species, particularly in collections from the tropics.

KEY TO SPECIES

Hypothallus, stalk and columella yellow or orange. b Hypothallus, stalk and columella white. c Spores pale, minutely warted, $11-13 \mu$. D. thomasii Spores dark, strongly and irregularly warted, 13–14 μ . D. megalospora Sporangia typically cylindrical to ovate, rarely subglobose; spores pale under lens, minutely roughened, 8-11 μ . D. leucopodia Sporangia globose or nearly so. Stalks usually half or more of total height; spores conspicuously marked. е d. Stalks usually short or lacking, rarely over half of total height; spores inconspicuously marked. Spores sparsely but prominently spiny or warted. D. bulbillosa e. Spores bearing prominent wart-like protuberances, these often forming a coarse and imperfect reticulation. D. splendens Spores minutely spiny or warted, 7-11 μ in diameter. D. radiata f. Spores faintly reticulate, 10–13 μ in diameter. D. subsessilis

Diachea bulbillosa (Berk. & Br.) A. Lister, in Penzig, Myxom. Buit. 45. 1898. Didymium bulbillosum Berk. & Br., Jour. Linn. Soc. 14: 84. 1873.

Diachea splendens Racib., Hedwigia 37: 54. 1898. Not D. splendens Peck, 1878.

Diachaeella bulbillosa (Berk. & Br.) Höhnel, Sitz.-ber. Akad. Wien 118: 437. 1909.

Sporangia gregarious, stipitate, subglobose or obovate, iridescent blue or purple, finally silvery, 0.3–0.5 mm in diameter, their total height 0.8–1.8 mm; stalk conic or subcylindric, expanded at the base, calcareous, white or brownish, usually longer than the sporangium; hypothallus often inconspicuous; columella white, calcareous, the lime of both stalk and columella, especially in tropical collections, often aggregated into crystalline nodules; capillitium lax, of purplish threads united into a net; spores dark in mass, violet-gray by transmitted light, sparsely and often irregularly but strongly warted, 7–11 μ in diameter. Plasmodium white to deep yellow.

FIG. 132 Plate XIV TYPE LOCALITY: Peradeniya, Ceylon. HABITAT: Dead leaves and litter.

DISTRIBUTION: Southern and eastern Asia; Massachusetts and Ontario, south to Kansas, Florida; Central America; West Indies; Colombia.

ILLUSTRATIONS: Sitz.-ber. Akad. Wien 118: 437, f. 34; Lister, Mycet. ed. 3. pl. 99, f. g, h; Macbr. & Martin, Myxom. pl. 10, f. 235; Hattori, Myxom. Nasu pl. 9, f. 3.

The lime may be granular or crystalline; it is frequently the latter, especially in tropical collections and this, as noted previously, was the basis for von Höhnel's genus *Diachaeella*. This character is variable in this as in other species of *Diachae*.

Diachea leucopodia (Bull.) Rost., Mon. 190. 1874.

Trichia leucopodia Bull., Hist. Champ. Fr. 121. 1791.

Stemonitis elegans Trent., in Roth, Cat. Bot. 1: 220. 1797.

Stemonitis leucostyla Pers., Syn. Fung. 186. 1801.

Stemonitis leucopodia (Bull.) DC., Fl. Fr. 2: 257. 1805.

Diachea elegans (Trent.) Fries, Syst. Myc. 3: 156. 1829.

Diachaea leucostyla (Pers.) Schw., Trans. Am. Phil. Soc. II. 4: 260. 1832.

Diachaea confusa Massee, Mon. 259. 1892.

Sporangia closely gregarious, stipitate, metallic blue, or iridescent purple or bronze, cylindric or ellipsoidal, rarely subglobose, obtuse, subumbilicate below, 0.4–0.6 mm in diameter, their total height 1–2 mm; stalk stout, brittle, calcareous, snow-white, one-fourth to one-half the total height, tapering upward; hypothallus white, calcareous, venulose, usually forming a conspicuous network from which the sporangia arise, sometimes sparse; columella thick, tapering, blunt, white, calcareous, over half the height of the sporangium and often nearly reaching the top; capillitium of branching and anastomosing, flexuous threads, brown except at the pale extremities, arising from all parts of the columella; spores nearly black in mass, dull lilaceous by transmitted light, minutely roughened, 8–11 μ in diameter. Plasmodium white.

TYPE LOCALITY: France.

HABITAT: Fallen leaves and sticks and often on living plants.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Bull., Herb. Fr. pl. 502, f. 2; Nat. Geogr. Mag. 49(4):
pl. 9; Lister, Mycet. ed. 3. pl. 99, a-c; Macbr. & Martin, Myxom. pl. 10,
f. 226-228; Hattori, Myxom. Nasu pl. 9, f. 1.

EXSICCATI: Rav., Fungi Car. 80; Ellis, N. Am. Fungi 336; Ellis & Ev., Fungi Columb. 2118; Sydow, Myc. Germ. 113; Jaap, Myxom. Exs. 10, 28, 107, 151, 173; Brândză, Myxom. Roum. I. 1: 9; II. 1: 29; III. 1: 16(NY); 86(IA); Thaxter, Rel. Farl. 390.

A very common and striking species. It has been reported as doing some damage in strawberry beds and sweet potato fields.

The lime is usually granular, but is sometimes in the form of crystalline nodules. According to G. Lister, this is the case in D. confusa Massee; she adds that this is not rare in D. leucopodia.

D. leucopodia var. globosa G. Lister, Mon. ed. 2. 118. 1911, is applied to forms with globose sporangia. We have collections with broadly ovate sporangia which may include some which are globose, but the intergradation is so complete that the variety seems superfluous.

FIG. 133

Plate XIV

The specific epithet was spelled *leucopodia* by Bulliard. Fries, Syst. Myc. 3: 156. 1829, cited it as *leucopoda*, and that spelling, adopted by Rostafinski and in all editions of the Lister monograph, has been widely used although there appears to be no convincing orthographical reason for the change. Fries had previously published *D. elegans* by implication in Syst. Orbis Veg. 143. 1825, and Rostafinski, Mon. 190. 1874, cites *D. elegans* Fries, Stirp. Femsj. 84. 1825, which we have not seen. If formally published before 1829, it is curious that Fries did not cite the earlier publication in the Systema.

Diachea megalospora Thind & Manocha, Mycologia 56: 715. 1964.

Sporangia stalked, globose or somewhat depressed, iridescent, slightly umbilicate below, 0.5–0.7 mm in diameter, total height 0.7–1 mm, coppery above merging into bluish below; peridium membranous, thin, iridescent, persistent, irregularly dehiscent, beginning at apex; stalk stout, expanding at base and tapering upward, calcareous, crystalline, light orange with violaceous tints, paler or whitish at base, up to 0.6 mm long; hypothallus profuse, calcareous, light orange with violaceous tints; columella conical, calcareous, crystalline, not attaining center of the sporangial cavity, concolorous with the stalk, of which it is a continuation; capillitium noncalcareous, dense, composed of violaceous brown, branching and anastomosing threads, tapering to the paler extremities; spores black in mass, deep violaceous brown to dark brown by transmitted light, globose, prominently and profusely verrucose, the warts irregular, dark, 0.5–1 μ long, with clusters of smaller, paler warts on the inner wall, (12.8–)13–14(–16) μ in diameter, including the warts. Plasmodium unknown.

TYPE LOCALITY: Mussoorie, India.

HABITAT: On living moss.

DISTRIBUTION: Known only from the type collection. ILLUSTRATIONS: Mycologia 56: 715, f. 3; 716, f. 4.

Similar to *D. thomasii* in its yellow lime, from which it is distinguished chiefly by its larger, darker, much more prominently warted spores, and by the paler, crystalline lime, with violaceous tints. As noted, the nature of the lime in *D. bulbillosa* is not always crystalline and additional collections may show that the same is true of *D. megalospora*. *D. thomasii* is known only from mountainous regions of the eastern United States and *D. megalospora* from the foothills of the Himalayas. In view of the differences noted and the wide geographical separation of the two species, although the latter may not be of great significance, they may provisionally be accepted as distinct.

Diachea radiata G. Lister & Petch, in Farq. & Lister, Jour. Bot. 54: 130. 1916.

Sporangia gregarious or crowded, sessile or rarely short-stalked, hemispheric or globose, 0.4–0.5 mm in diameter, iridescent silvery, gray or bronze, seated on or imbedded in a white hypothallus; peridium membranous, nearly colorless by transmitted light, shining; stalk, when present, usually short and stout, but sometimes over half the total height, furrowed, calcareous, white; columella white, calcareous, convex, conic or short-cylindric, sometimes lacking; capillitium a network of purple-brown threads radiating from the columella or from the base of the sporangium; spores pale violet-gray by transmitted light, distinctly warted or spinulose, 8–11 μ in diameter. Plasmodium orange-yellow.

TYPE LOCALITY: Ceylon.

HABITAT: Dead leaves and stems.

FIG. 134 Plate XIV DISTRIBUTION: ?Iowa, ?Florida, Panama; India; Ceylon; Nigeria. ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 211.

The Iowa specimen which was the basis for the report by Martin (1949) of the occurrence of the species in Iowa has disappeared from our collection. The species is represented in our herbarium by two specimens, both from the Panama Canal Zone, in one of which the stalks are up to % the total height. The small size, delicate capillitium and somewhat larger spores with faint clusters of warts may be used provisionally to separate this species from D. leucopodia. The orange plasmodium, if it can be seen, is another character which may be useful. The lime in both of our specimens is in the form of crystalline nodules.

Diachea splendens Peck, Ann. Rep. N. Y. State Mus. 30: 50. 1878.

FIG. 135 Plate XIV

Diachea bulbillosa var. splendens (Peck) G. Lister, Mycet. ed. 3. 103. 1925. Sporangia gregarious, stipitate, globose, metallic-iridescent blue, 0.3–0.6 mm in diameter, their total height 1–1.5 mm; stalk subcylindric or conic, calcareous, usually equaling or exceeding the sporangium; hypothallus white, calcareous, venulose; columella white, limy, clavate, exceeding the center of the sporangium; capillitium a lax network of slender, brown threads; spores black in mass, pallid by transmitted light, marked with coarse, dark, wart-like protuberances and ridges arranged in a partial reticulation, the body 7–10 μ in diameter, the total diameter, including the warts, 10–11(-12) μ . Plasmodium orange.

TYPE LOCALITY: North Greenbush, N. Y.

HABITAT: Leaves, herbaceous stems, and dead wood.

DISTRIBUTION: Massachusetts to Minnesota, south to Virginia and Kansas; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 99, d-f; Macbr. & Martin, Myxom. pl. 10, f. 229, 230.

Distinguished from D. bulbillosa, of which G. Lister regarded it as a variety, by the striking spores, on which the warts may attain a height of $2.5~\mu$. Hagelstein said these are not warts, but protuberances, but the distinction is perhaps overstressed.

Indira (1965) reports growing the species from spore to spore in culture. The fructifications so secured were often sessile, and the spores were very variable in size and markings, much more so than in the original collection from which they were grown.

Diachea subsessilis Peck, Ann. Rep. N. Y. State Mus. 31: 41. 1879.

FIG. 136 Plate XIV Sporangia gregarious or crowded, stipitate or sessile, rarely plasmodio-carpous, greenish gray varying to dull iridescent blue, 0.4–0.8 mm in diameter, the total height 0.6–1 mm; stalk conic, calcareous, not exceeding the sporangium in height, often much shorter or lacking, white, dull gray, or brownish; hypothallus netted, scanty, somewhat calcareous or limeless; columella short, conic, rarely lacking; capillitium delicate, radiating from the columella, of branching and anastomosing threads, light brown, with pale tips; spores dark in mass, pallid under the lens, minutely spiny, the spines connected by a delicate reticulation, 8–11(–12) μ in diameter. Plasmodium yellow.

TYPE LOCALITY: Adirondack Mts., N. Y. HABITAT: Dead leaves and wood.

DISTRIBUTION: Massachusetts to Ontario, south to Florida and west to Colorado; Europe; Ceylon; Java.

ILLUSTRATIONS: Lister, Mycet. ed. 3 pl. 100; Macbr. & Martin, Myxom. pl. 10, f. 231, 232; Hattori, Myxom. Nasu pl. 9, f. 2.

EXSICCATI: Jaap, Myxom. Exs. 152.

The rather scanty lime, the short columella, the conical stalks, the delicately reticulate spores and the pale, slender capillitium distinguish this species. A few specimens with somewhat larger and more prominently reticulate spores are for the present included.

G. Lister, Mycet. ed. 3. 104. 1925, suggested that *Lamproderma fuckelianum* Rost., Mon. 208. 1874, may be a nearly limeless form of this species. If this should be verified, Rostafinski's epithet would have precedence.

Diachea thomasii Rex, Proc. Acad. Phila. 44: 329. 1892.

Sporangia gregarious to crowded, sessile or short-stipitate, globose, iridescent bronze or purple, 0.5–0.9 mm in diameter, the total height 0.6–1.2 mm; stalk, when present, short, thick, tapering upward, densely charged with orange lime-granules; columella orange or deep yellow, rough, cylindric or conic, obtuse, attaining one-half the height of the sporangium; capillitium lax, of slender, rigid, branching and anastomosing, brown threads, radiating from all parts of the columella; hypothallus orange, venulose, sometimes continuous; spores brown in mass, pale violaceous by transmitted light, minutely warted, sometimes with faint or conspicuous scattered clusters of larger and darker warts, 11– $13~\mu$ in diameter. Plasmodium deep yellow.

TYPE LOCALITY: Cranberry, North Carolina.

HABITAT: Mossy bark of dead trees.

DISTRIBUTION: Pennsylvania, North Carolina, Tennessee.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 101; Macbr. & Martin, Myxom. pl. 10, f. 233, 234.

Distinguished from other species of the genus except *D. megalospora* by the orange hypothallus, stalks and columellae; from *D. subsessilis*, which appears to be closest to it in other respects, by these characters and by the coarser capillitium and the larger, delicately warted spores with scattered clusters of darker warts.

Rex, Proc. Acad. Phila, 46: 289. 1894, reported on a collection from the type locality, forming clumps of 12–20 sporangia with the stalks fused and sometimes also the sporangial walls, so as to form pseudoaethalia; the color of the peridial wall was a metallic purple and the capillitium bore numerous dark bulbous thickenings. He attributed the differences as due to the very wet season of 1894.

Schenella

Macbr., Mycologia 3: 39. 1911.

Fructification a pseudoaethalium, expanded, depressed, covered by a fragile continuous cortex. Sporangia columnar, erect, each with cup-like constricted base and persistent cap-like lid which is firmly attached to the cortex, the peridium persistent at the apex and more or less so at the base, otherwise fugacious. Columella none. Capillitium of numerous, tortuous, unbranched or sparsely branched threads attached at base and at lid and more or less coiled into columnar strands, each strand representing a sporangial unit. Spores black in mass.

FIG. 137 Plate XIV Type species, Schenella simplex Macbr.

Macbride, in proposing the genus, gave an excellent description of the type species, but he was not entirely convinced that it was a myxomycete and did not mention it in the second edition of his monograph (1922) nor did G. Lister (1925) in the third edition of the *Mycetozoa*. Macbride and Martin (1934) did recognize it, but both Hagelstein (1944) and Martin (1949) made only casual reference to it as doubtful.

The finding of a second species (Martin, 1962) and restudy of the type material leaves little doubt that the genus is valid and should be included in the Stemonitaceae. Nannenga-Bremekamp (1967) believed that the peculiar character of the capillitium, which is, as she says, quite unlike that of any other member of the Stemonitaceae, justified its segregation in a separate family, the Schenellaceae.

KEY TO SPECIES

a. Capillitium smooth; spores
 black in mass, distinctly verrucose, 5–6 μ.

S. simplex

 a. Capillitium rough; spores fuscous in mass, minutely roughened, 3–4 μ.

S. microspora

Schenella microspora Martin, Mycologia 53: 28. [1961] 1962.

FIG. 138 Plate XIV Pseudoaethalium pulvinate, corticate, up to 4 cm in length, 1 cm wide and about 5 mm thick; cortex fragile, pale, early breaking away; sporangia slender, peridia fugacious except for remnants at apex and base; capillitium and spores deep fuscous in mass; capillitium of unbranched, tortuous threads, extending from base to apex, and united into columnar strands, each strand representing the capillitial system of a single sporangium, the threads brown under the lens, distinctly roughened, 2–6 μ in diameter; spores globose, minutely verrucose, bright yellow-brown under lens, 3.5–4(–4.5) μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Big Basin State Park, San Mateo Co., California. HABITAT: Large fallen trunk of Sequoia sempervirens. DISTRIBUTION: Known only from the type collection. ILLUSTRATIONS: Mycologia 53: 26, f. 1, 2, 4.

As in the case of S. simplex, the type material is now badly shattered, but when first seen the very fragile peridium was nearly intact and the species probably did not differ significantly from S. simplex in external appearance except for the somewhat more ferruginous color of the mass of capillitium and spores. The constituent sporangia are more slender than in S. simplex, the basal cups and the caps are less strongly developed, the capillitium is roughened and the spores are substantially smaller and smoother. These characters, taken together, seem to justify regarding it as a distinct species.

Schenella simplex Macbride, Mycologia 3: 39. 1911.

FIG. 139 Plate XIV Pseudoaethalium oval in outline, expanded, depressed, attaining a length of 4 cm, a width of 2 cm and 3 mm thick; cortex continuous, with minute bosses indicating position of tops of sporangia, pallid or gray, somewhat shining; sporangia erect, columnar, attached at bases and tips where peridium, elsewhere fugacious, persists; capillitium black, profuse, of sinuous, smooth, unbranched threads mostly $3-4~\mu$ in diameter, remaining united and coiled into columnar

strands; spores globose, black in mass, bright yellowish brown by transmitted light, distinctly verrucose, 5–6 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Yosemite National Park, California.

HABITAT: On pine log.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATIONS: Mycologia 3, pl. 36, f. 1-7; 53: 26, f. 1, 3, 4.

The type collection is now badly shattered, but Macbride's illustrations give a clear idea as to how it appeared when first collected. His magnifications are incorrect, probably because allowance was not made for reduction in copying them. In all other respects the material confirms his account.

Colloderma

G. Lister, Jour. Bot. 48: 312. 1910.

Sporangiate, sessile; peridium double, the outer layer gelatinous when moist, drying horny, the inner layer membranous; columella lacking; capillitium slender, hyaline to dark, radiating from base, branching and anastomosing to form a reticulate net; spores dark.

Type species, Didymium oculatum Lippert.

Nannenga-Bremekamp (1967) stated that an outer gelatinous wall occurs in other genera and is not, in such cases, regarded as of sufficient importance to justify a separate genus, much less a family, hence she includes *Colloderma* in the Stemonitaceae. In this decision we concur.

KEY TO SPECIES

a. Sporangia dark, shining; spores pale gray under lens, mostly 11–12 μ .

C. oculatum

 a. Sporangia brown, duller; spores dark gray under lens, mostly 14–16 μ.

C. robustum

Colloderma oculatum (Lippert) G. Lister, Jour. Bot. 48: 312. 1910.

Didymium oculatum Lippert, Verh. Zool.-Bot. Ges. Wien 44: Abh. 72. 1894. Colloderma dubium Krzem., Acta Soc. Bot. Pol. 11: Supp. 124. 1934.

FIG. 122 Plate XIII

Sporangia scattered or gregarious, sessile or rarely stalked, or forming short plasmodiocarps, 0.3–1(–1.2) mm in diameter, olivaceous or purple-brown, glossy, sometimes seated on a brownish purple hypothallus; peridium double, the inner layer membranous, firm, colorless, the outer layer, when moist, thick, gelatinous, hyaline, sometimes more or less encrusted with olivaceous granules, shrinking and becoming horny when dry; columella lacking; capillitium a network of hyaline, brownish or purplish threads arising from the base of the sporangium, 2–4 μ thick at base, very slender and colorless at the tips, often surrounded by a broken hyaline sheath or bearing dark accretions; spores black in mass, smoky gray by transmitted light, echinulate, (10.5–)11–12.5(–13) μ in diameter. Plasmodium purplish brown.

TYPE LOCALITY: Austria.

HABITAT: Dead wood covered with mosses and lichens.

DISTRIBUTION: Widely distributed in Europe; in the United States known from New Hampshire, Vermont, Pennsylvania, Oregon; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 214, f. a-d; Macbr. & Mart., Myxom. pl. 10, f. 220-222; Hattori, Myxom. Nasu pl. 8, f. 6; Acta Soc. Bot. Pol. 11, Supp. pl. 5, f. 1-7; pl. 6, f. 12-16 (as C. dubium).

This species appears to be not uncommon in Europe, but rare or perhaps overlooked in North America. An ample collection from Poland, as *C. dubium*, differs from American gatherings only in the slightly larger size of the sporangia and the scantier gelatinous layer when moistened. Krzemieniewska implies and Meylan stresses the lack of a gelatinous outer layer, but it is present in the material we have although in scantier amount than in other specimens.

In the original description G. Lister speaks of two sporangia on a common stalk, and Meylan (1933) illustrates very broad basal stalks on what he later regarded as C. dubium. We have not observed such structures, but we have seen sporangia developed at the slender tip of a moss leaf, surrounded by a film of hypothallus, which appeared stalked.

Colloderma robustum Meylan, Bull. Soc. Vaud. Sci. Nat. 58: 83. 1933.

FIG. 123 Plate XIII Colloderma oculatum var. castaneum Krzem., Acta Soc. Bot. Pol. 11: Supp. 123, 1934.

Sporangia sessile, pulvinate, circular or oval in outline, 1–2 mm broad; peridium double, the outer layer gelatinous when wet, horny when dry, the inner layer membranous, yellow, translucent, bearing plasmatic deposits; capillitium abundant, dark, slender, rigid, branched at acute angles; spores black in mass, dark gray by transmitted light, markedly echinulate, (13-)14-16(-17) μ in diameter. Plasmodium probably blackish gray.

TYPE LOCALITY: Casseron, Switzerland.

HABITAT: Dead wood, associated with mosses.

DISTRIBUTION: Switzerland, Hungary, New South Wales.

ILLUSTRATIONS: Lister, Mycet. ed. 3, pl. 214, f. e (as C. oculatum).

This species differs from *C. oculatum* in its larger and darker spores, its duller and thicker peridium, and apparently more robust habit. Meylan said it agreed perfectly with specimens from New South Wales sent to him by Miss Lister as *C. oculatum* "var. robustum," an unpublished name. The present description is based on Meylan's description and a small but excellent collection of *C. oculatum* var. castaneum Krzem. sent by Mme. Krzemieniewska, which agrees admirably with Meylan's description. It seems probable that the capillitium and spores shown in G. Lister's plate 214, f. e, were drawn from the New South Wales collection, although that is not stated.

Leptoderma

G. Lister, Jour. Bot. 51: 1. 1913.

Sporangiate, sessile or with a short, thick stalk. Peridium tough-membranous with dark, granular inclusions, thicker at the base, where small scale-like aggregations of crystalline lime are usually imbedded. Columella dark when present, often lacking. Capillitium dark, netted, bearing granular nodules. Spores dark in mass.

Type species, Leptoderma iridescens G. Lister.

A most curious genus, based on a single species which suggested to the author a nearly limeless phase of a *Lepidoderma*. G. Lister, Mycet. ed. 3. p. 127, compares it with *Diachea*, with which it does have much in common, although the

scanty amount of lime present marks it off sharply from that genus. It is perhaps closer to *Diacheopsis*, and the latter genus may eventually have to be merged with *Leptoderma*. Until more material is available for study, both genera may be maintained provisionally.

A single species.

Leptoderma iridescens G. Lister, Jour. Bot. 51: 1. 1913.

Sporangiate or subplasmodiocarpous, scattered or clustered, grayish purplebrown; sporangia rarely short-stipitate, more commonly sessile on a restricted base, varying to pulvinate or elongate and often fused to form subplasmodiocarpous groupings, 0.5–0.8 mm in diameter in the basal portion; peridium tough-membranous, glossy, iridescent, often striately wrinkled and often including in or near the base crystalline flakes of lime 2–15 μ in diameter; stalk, when present, short, stout, dark, spreading below into the dark hypothallus; columella dark, convex, sometimes lacking; capillitium a persistent network of flexuous blackish threads, radiating from the columella or base of the sporangium, the tips and base of the threads pale, the bases often expanded or tubular and enclosing dark granular matter, often with similar nodules on the upper part of the threads; spores dark brown in mass, violaceous gray by transmitted light, rather coarsely and irregularly warted, 10–13 μ in diameter. Plasmodium gray or drab.

TYPE LOCALITY: England.

HABITAT: Plant litter of various sorts.

DISTRIBUTION: Great Britain, Germany, Switzerland; PMaine; Colorado,

Oregon, California.

ILLUSTRATIONS: Lister, Mycet. ed. 3, pl. 131, f. h, i; pl. 218, f. i, m; Schinz, Myxom. 204, f. 77.

Our best material is from Colorado. A collection from California and another from Oregon were put aside by Macbride as possibly representing a new species of *Lepidoderma* long before *Leptoderma* was described, but his herbarium name was never published. Both are over-mature. A collection by Thaxter from Maine, now in the New York Botanical Garden (NY 7942), tentatively referred to this species by Hagelstein, may represent it, but it is completely limeless and without capillitium.

Diacheopsis

Meylan, Bull. Soc. Vaud. Sci. Nat. 57: 149. 1930.

Sporangia sessile, or borne on weak, strand-like stalks, subglobose to pulvinate; peridium membranous, delicate, translucent, shining with metallic reflections, persistent; columella none; capillitium arising from the base, branching and anastomosing, forming a loose net; spores dark.

Type species, D. metallica Meylan.

Differing from Lamproderma in the lack of a columella and in the origin of the capillitium. The author compares the type species with Lamprodermopsis nivalis Meylan, i.e. Dianema nivale (Meylan) G. Lister, which, however, has the pale spores characteristic of Dianema.

FIG. 363 Plate XLI

- Spores sparsely papillose, 6-7 μ in diameter.
- Spores 12 μ or more in diameter, spinulose.

D. pieninica

Spores long-spinulose, $12-14 \mu$ in diameter.

D. metallica D. insessa

Spores minutely spinulose, (?14-)18-19 μ in diameter.

Diacheopsis insessa (G. Lister) B. Ing, Trans. Brit. Mycol. Soc. 48: 648. 1965. Lamproderma insessum G. Lister, Trans. Brit. Mycol. Soc. 4: 41. 1913.

Sporangia sessile, or rarely with weak stalks, densely clustered, subglobose or sometimes subplasmodiocarpous, iridescent purple, 0.8 or more mm in diameter, up to 3 mm long; peridium membranous, pale purple; columella lacking; capillitium arising from the base as a scanty, very loose network of broad purplish threads, often expanding at the junctions and marked with a few bead-like thickenings; spores dark brownish purple, closely spinulose, (?14-)18-19 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Forres, Scotland.

HABITAT: On exposed areas of erect plants.

DISTRIBUTION: Scotland; British Columbia; California. ILLUSTRATION: Lister, Mycet. ed. 3, pl. 215, f. e, f.

We have no authentic specimens of this species. The descriptions and illustrations in the Lister monograph are convincing. A collection from British Columbia, DAVFP 16651, which fruited on living Pseudotsuga is provisionally referred to this species. The sporangia are large for the species, 1-3 mm in diameter; the peridium is dark, brownish, with metallic lustre; the spores are dark, distinctly paler on one side, minutely spinulose, and only 14-15 μ in diameter, significantly smaller than as reported from the Scottish collections. It may be distinct, but in view of the apparent rarity of the species, it would be premature to describe it as new until more is known about the possible variation in these characters. A collection from M. Shasta, WBC 10206 has slightly smaller, minutely echinulate spores and some of the sporangia are borne on weak stalks, evidently portions of the hypothallus.

Diacheopsis metallica Meylan, Bull. Soc. Vaud. Sci. Nat. 57: 149. 1930.

Sporangia subglobose, flattened, pulvinate, gregarious or clustered, 1-2 mm in diameter; peridium membranous, translucent, with bluish, greenish or dark golden reflections; columella none; capillitium of branching and anastomosing filaments arising from the base of the sporangium and forming a network, the junctions sometimes expanded; spores dark, globose, bearing long spines, 12-14 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Canton Neuchâtel, Switzerland.

HABITAT: On living Sorbus, at border of melting snow.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATION: Bull. Soc. Vaud. Sci. Nat. 57: 148, f. 1, 2, 4.

We have seen no specimens.

Diacheopsis pieninica Krzem., Kosmos A. 65: 190. 1947.

Sporangia sessile, cylindrical, about 0.5 mm in diameter, 0.6 mm tall, crowded on a hypothallus of membranous brown strands; peridium persistent, membranous, shining, nearly colorless above, thicker and brown, and spotted with dark-outlined, nearly colorless patches below; columella none; capillitium of dark brown threads branching at wide angles and forming a network connected by paler tips with the peridium and the base of the sporangium, often bearing thickenings and in the lower part becoming transformed into membranous strands, the nodes scarcely expanded; spores nearly black in mass, violet-brown by transmitted light, sparsely warted, 6-7 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Pieniny, Poland. HABITAT: Presumably on forest litter.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATION: Krzem., Sluz., pl. 11, f. 5.

The preceding description is based almost entirely on the English description given at the end of the paper cited. There is a somewhat modified one in the Polish language in Sluz. 204. 1960. The species seems clearly to fit into Diacheopsis and the relatively very small spores separate it sharply from the other two species.

Enerthenema

Bowman, Trans. Linn. Soc. 16: 152. 1830.

Ancyrophorus Raunk., Bot. Tidsskr. 17: 92. 1888.

Sporangiate, stipitate, the stipe continued as a columella to the top of the sporangium and there expanding into a shallow cup or cup-like disk from which the capillitium depends. Peridium fugacious. Spores dark.

Type species, Enerthenema elegans Bowman.

KEY TO SPECIES

Spores clustered in groups of 4-12.

E. berkeleyanum

Spores free.

Spores minutely warted, $10-12 \mu$;

E. papillatum

Spores coarsely warted, 11–14 μ ; apical disk 0.3-0.5 mm in diameter.

E. melanospermum

Enerthenema berkeleyanum Rost., Mon. App. 29. 1876.

Enerthenema syncarpon Sturgis, Colo. Coll. Publ. Sci. 12: 448. 1913.

apical disk not exceeding 0.2 mm in diameter.

Enerthenema papillatum var. syncarpon (Sturgis) G. Lister, in Lister, Mycet.

ed. 3. 150. 1925.

Sporangia globose, stalked, deep brownish black, gregarious or scattered, 0.4-0.7 mm in diameter, 0.8-1 mm tall; stalk black, continued into the sporangium as a columella and tipped by a small, shining, discoid cup from which the capillitium depends; threads of the capillitium coarse, black, rough, sparsely branched, flexuous; spores deep fuscous in mass, bright yellow-brown by transmitted light, united in clusters of mostly 4-12, bearing long spines on the exposed surfaces, nearly smooth elsewhere, globose when separated, 11–13 μ in diameter. Plasmodium unknown.

FIG. 140 Plate XV TYPE LOCALITY: South Carolina.

HABITAT: Dead wood.

DISTRIBUTION: Nova Scotia, New Hampshire, Massachusetts, New York,

New Jersey, North Carolina, South Carolina, Colorado, Texas.

EXSICCATI: Thaxter, Rel. Farl. 396.

This species appears to be uncommon but is quite constant in collections from widely scattered localities. The record from Nova Scotia is based on Hagelstein's collection in Long Island on lath from Nova Scotia. It was listed by Berk. & Br., Ann. Mag. Nat. Hist. II. 5: 366. 1850, under *E. elegans* Bowman. This does not constitute publication of "E. elegans Berk. & Br." as cited by Cooke, Myxom. Gt. Brit. 52. 1877, and copied in later works.

Enerthenema melanospermum Macbr. & Martin, in Martin, Jour. Wash. Acad. 22: 91. 1932.

FIG. 141 Plate XV Sporangia intense black, gregarious in small clusters of 3–12, these in larger aggregations, globose or oval, stalked, 0.8–1 mm in diameter, 2 mm or more tall; stalk black, shining, rather stout, attenuate upward and continued as a slender, unbranched columella capped with a large, shining, infundibuliform terminal disk 0.3–0.5 mm in diameter; capillitium dense, black, freely branched, arising from the terminal disk, the ends free; spores free, black in mass, dark olivaceous by transmitted light, coarsely warted, 11–14 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Three Sisters Mts., Oregon.

HABITAT: Dead wood.

DISTRIBUTION: Washington, Oregon, California.

ILLUSTRATIONS: Jour. Wash. Acad. 22: 90, f. 6, 7; Macbr. & Martin, Myxom. pl. 13. f. 307, 308.

Differing from *E. papillatum* in its black color without suggestion of fuscous, its robust habit, its large, conspicuous apical disk and its larger and more coarsely warted spores. Known thus far only from the Cascade Mountains of the western United States.

FIG. 142 Plate XV Enerthenema papillatum (Pers.) Rost., Mon. App. 28. 1876.

Stemonitis papillata Pers., Neues Mag. Bot. 1: 90. 1794.

Trichia notata Schum., Enum. Pl. Saell. 2: 211. 1803.

Arcyria atra Schum., Enum. Pl. Saell. 2: 215. 1803.

Stemonitis mammosa Fries, Syst. Myc. 3: 161. 1829.

Enerthenema elegans Bowman, Trans. Linn. Soc. 16: 152. 1830.

Comatricha papillata (Pers.) Schroet., Krypt.-Fl. Schles. 3(1): 118. 1885.

Ancyrophorus crassipes Raunk., Bot. Tidsskr. 17: 93. 1888.

Sporangia globose, stalked, fuscous, becoming purplish or ferruginous after spore discharge, 0.4–0.7 mm in diameter, 1–1.5 mm tall; stalk black, opaque, attenuate above, about equal to the sporangium, extending as a columella to the top of the sporangium and there expanded as a small, shining, cupulate or funnel-shaped disk not exceeding 0.2 mm in diameter, the basal part of the sporangial wall often remaining attached to the stalk as a ring after dehiscence; capillitium depending from the apical disk, the threads long, dark, flexuous, sparsely branched; spores free, olivaceous fuscous in mass, grayish brown by

transmitted light, minutely warted, 10–12 μ in diameter. Plasmodium watery white.

TYPE LOCALITY: Germany.

HABITAT: Dead wood and bark, often of living trees.

DISTRIBUTION: Throughout the United States and Canada; north temperate regions; Chile; Australia.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 128, a-e; Macbr. & Martin, Myxom. pl. 13, f. 305, 306; Hattori, Myxom. Nasu pl. 11, f. 4.

EXSICCATI: Jaap, Myxom. Exs. 94; Thaxter, Rel. Farl. 395

The variety carneo-griseum Meylan (Bull. Soc. Vaud. Sci. Nat. 51: 268. 1917), known only from Switzerland, is said to be distinguished by its lilaceous gray spores. Such a slight color variation does not seem to warrant a name.

This common, but rather inconspicuous species is probably cosmopolitan.

Stemonitis

Roth, Mag. Bot. Römer & Usteri 1(2): 25. 1787.

Symphytocarpus B. Ing & Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 60: 218. 1967.

Sporangiate, the sporangia cylindric, stalked, gregarious or densely clustered; stalk extending into the sporangium as a columella; capillitium arising from the entire length of the columella, branching repeatedly, the final branches united with a surface net developed under the peridium; peridium fugacious at maturity, leaving the spore mass enclosed by the surface net; spores black, fuscous, brown or ferruginous in mass, violaceous-brown to nearly colorless by transmitted light; hypothallus membranous, usually well developed, often common to a cluster. Stemonites and Stemionitis are alternative spellings found in the literature.

Type species, Stemonitis fusca Roth.

Stemonitis is distinguished from Comatricha by the presence of a surface net developed just under the peridium and independently from the capillitium arising from the columella, the ultimate branches of which fuse with the net. The net does not appear to be a part of the peridium remaining after the interstices have dropped away, as in Cribraria. Species of Comatricha with dense capillitium, C. typhoides and C. pulchella e.g., may appear to have a surface net, but careful observation seems to show that is not the case. Nevertheless, the distinction is not always clear and the newer classifications, while not yet satisfactory, may suggest the way to future clarification.

The genus has traditionally been ascribed to Gleditsch, 1753, but since his work is cited by Linnaeus in the Species Plantarum of the same year, it must be regarded as pre-Linnaean. Wiggers, Prim. Fl. Holsat. 110. 1780, adopted Gleditsch's name for a single species, Stemonitis typhina, which is almost certainly what is now known as Comatricha typhoides. Willdenow used Wiggers' name in 1787, the same year in which Roth published S. fusca; in 1788 Roth used S. typhina and S. fusca for two distinct species. Clearly S. typhina Wiggers should, according to the Code, be the type of Stemonitis. To recognize it as such would require many name changes and cause great confusion, whereas acceptance of the genus as typified by S. fusca permits it to be retained in its current usage.

Many of the species are difficult to define and hence difficult to key. An important key character, frequently used, is the presence or absence of reticulations on the spores. Sometimes these are clear, as in S. trechispora and many collections of S. fusca. More often they are faint and hard to see except with the use of an oil immersion objective. However, after some experience, they may usually be

detected under a high dry objective focussed carefully on the spore surface and with illumination properly adjusted.

Nannenga-Bremekamp (1967) restricted Stemonitis to species with cylindrical sporangia, well-marked surface nets and smooth, hollow stalks, with particular emphasis upon the character of the stalks. This was more fully developed by Ing and Nannenga-Bremekamp (1967), where most of the excluded species are referred to their new genus Symphytocarpus.

KEY TO SPECIES

KEY	KEY TO SPECIES					
a.	Spores reticulate, the reticulations prominent or faint, rarely lacking.					
a.	Spores spiny to warted or smooth, not reticulate.					
	b. Spores prominently but often incompletely banded-reticulate.					
	b. Spores spiny-reticulate,					
	verrucose-reticulate, or, if banded-reticulate	e, the bands faint. d				
c.	Sporangia 2-5 mm tall, nearly black,					
	short-stalked or sessile, in dense,	g . 1.				
	sometimes agglutinated clusters; spores 11–13 μ					
c.	Sporangia under 3 mm tall, brown, distinctly sta in small but not agglutinated clusters; spores 7-	lked, -8 μ. S. inconspicua				
	d. Sporangia deep fuscous to black, usually fruiting in dense clusters.	e				
	d. Sporangia vinaceous or lilac,					
	usually fruiting in loose clusters.	f				
e.	Clusters small, black; sporangia 2-5 mm tall;					
	stalk usually less than one-fourth total					
	height; spores distinctly spiny-reticulate, 8–9 μ .	S. nigrescens				
e.	Clusters large, conspicuous, fuscous					
	to deep reddish brown; sporangia mostly 6–20 mm tall; stalk usually over					
	one-fourth total height; spores prominently					
	to delicately warted-reticulate, 7.5-9 μ .	S. fusca var. fusca				
	f. Sporangia lilaceous brown; surface net tending to be fugacious above; spores rathe conspicuously verrucose-reticulate, mostly 7	r				
		~				
	f. Sporangia somewhat darker, spores usually	under $\mathfrak{b} \mu$.				
g.	Sporangia purplish ferruginous, 2.5–5 mm tall; surface net often fugacious above; spores					
	faintly and irregularly banded-reticulate, 5–6 μ .	S. hyperopta				
g.	Sporangia dark lilaceous brown,	z. ngperopid				
g.	1.7–3.2 mm tall; surface net persistent					
	above; spores delicately reticulate, 3.2–4.5 μ .	S. microsperma				
	h. Spores united in clusters; sporangia always	•				
	h. Spores free; sporangia dark or pale.	j				
i.	Sporangia free at bases and apices,	,				
	connate between, with discoid					
	platelets at junctions between					
	adjacent sporangia; spores pale, 12-13 μ .	S. confluens var. syncarpon				
i.	Sporangia densely clustered, more or					
	less united, sometimes into a					
	pseudoaethalium but without discoid platelets at junctions of sporangia; spores dark, 8-10 μ .	C amiliana				
		S. uvifera				
	j. Deep fuscous to black.	k				
	j. Brown to vinaceous or pallid.	n				

k. Sporangia free at bases and apices, elsewhere united by capillitial branches bearing discoid platelets at S. confluens var. confluens junctions; spores pale, spinulose, $11-12 \mu$. Sporangia gregarious or massed, but not united by branches bearing platelets. 1 Capillitium dense, with many branches; meshes of surface net delicate, mostly 30 μ or less; S. fusca var. papillosa spores papillate to nearly smooth, 7.5–9 μ . Capillitium open, with few branches; meshes of surface net coarse, many 30-100 μ . Sporangia short, obtuse, short-stalked, up to 3.2 mm in total height; meshes of surface net brown, conspicuously broad and flattened; S. mussooriensis spores prominently spiny-warted, $10.5-12.5 \mu$. Sporangia, when well-developed, notably long, acuminate, 10-20 mm or more in total height; meshes of surface net reddish brown, often with metallic reflections; spores minutely warted, 7-9 μ . S. splendens Spores nearly smooth, rarely reaching 7 μ . Spores distinctly warted, usually over 7 μ . p Sporangia bright ferruginous, often in large S. axifera fruitings, usually 7-15 mm tall; spores 5-7 μ . Sporangia pale ferruginous, in S. smithii small tufts, 2–6 mm tall; spores 4–5 μ . Bright brown; stalk rarely attaining one-third total height, often much shorter; surface net S. herbatica persistent above; often fruiting on living plants. Dull brown or pallid; stalk usually one-third or more of total height; surface net tending to be

q. Wood-brown; columella giving rise to many coarse branches with expanded nodes and

tending to expand into a cup-like enlargement at tip.

S. flavogenita

q. Drab or pale; columella may attain the apex, but often dispersed well below tip; capillitium delicate.

S. pallida

q

Stemonitis axifera (Bull.) Macbr., N. Am. Slime-Moulds 120. 1889.

Trichia axifera Bull., Hist. Champ. Fr. 118. 1791.

Stemonitis fasciculata Schum., Enum. Pl. Saell. 2: 216. 1803. Not S. fasciculata Pers., 1791.

Stemonitis ferruginea Ehrenb., Sylvae Myc. Berol. 25. 1818.

Stemonitis microspora A. Lister, ex Morgan, Jour. Cinc. Soc. Nat. Hist. 16: 138. 1894, in part.

Sporangia cylindric, acuminate, bright rusty brown, becoming pale brown, 7–15(–20) mm tall, fasciculate in small or medium-sized clusters, occasionally in large fruitings, arising from a membranous hypothallus; stalk black, shining, 3–7 mm tall; columella branching freely and evenly, dissipated below the apex; surface net delicate, small-meshed, persistent; spores bright reddish brown in mass, pale by transmitted light, nearly smooth or minutely punctate, 5–7(–7.5) μ in diameter. Plasmodium white or pale to bright yellow.

FIG. 143 Plate XV TYPE LOCALITY: France. HABITAT: Dead wood.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Bull., Herb. Fr. pl. 477, f. 1, A-G; Lister, Mycet. ed. 3. pl. 119, e-g; Hattori, Myxom. Nasu pl. 20, f. 5.

EXSICCATI: Rav., Fungi Car. 75, 788; Ellis, N. Am. Fungi 1118; Jaap, Myxom, Exs. 112, 197; Sydow, Myc. Mar. 1085; Thaxter, Rel. Farl. 419 (as S. smithii).

In all three editions of the Lister monograph, Ehrenberg's name is used. It is true, as G. Lister (1925) remarks, that Bulliard's synonymy is not helpful, but that is also true of many other species of *Stemonitis*. Bulliard's description and illustrations apply very well to this species, and are, in fact, far superior to many later descriptions that are regarded as satisfactory.

Stemonitis fasciculata Schum. was based on Trichia axifera Bull., and is a later homonym of S. fasciculata Pers. Stemonitis microspora was used by A. Lister as a herbarium name but published by Morgan. It seems to have been applied to small, and small-spored phases of the present species and also to what Macbride described as S. smithii, here retained as a separate species but reduced to a variety by G. Lister (1911), and to small-spored forms of S. hyperopta. A very scanty specimen in the Morgan collection has spores 5μ in diameter and appears to be typical S. axifera.

Stemonitis confluens Cooke & Ellis, Grevillea 5: 51. 1876.

FIG. 144 Plate XV Comatricha confluens (Cooke & Ellis) Cooke & Ellis, Ann. Lyc. N. Y. 11: 396. 1877.

Stemonitis splendens var. confluens (Cooke & Ellis) A. Lister, Mycet. 112. 1894.

?Symphytocarpus confluens (Cooke & Ellis) B. Ing & Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 70: 219. 1967.

Sporangia closely fasciculate on a persistent hypothallus, short-stalked or sessile, separated at the tips and usually at the bases, elsewhere completely united, deep fuscous to almost black; total height 2–3 mm; columella dark, often failing to attain the apex; capillitium dense, often with membranous expansions, united to the irregular but mostly large-meshed surface net, the branchlets of adjacent sporangia often united and bearing, at the point of union, persistent disk-like platelets derived from the sporangial walls; spores black in mass, pale purplish brown by transmitted light, distinctly spinulose, $11-12~\mu$ in diameter. Plasmodium white.

TYPE LOCALITY: Newfield, New Jersey.

HABITAT: Dead wood.

DISTRIBUTION: New York, New Jersey, Pennsylvania, North Carolina, Illinois: Great Britain.

ILLUSTRATIONS: Macbr., N. Am. Slime-Moulds ed. 2. pl. 11, f. 4, 4a, 5; Macbr. & Martin, Myxom. p. 11, f. 255, 256.

We have two specimens from J. B. Ellis, one of them sent to Wingate as part of the type, the other sent by him to Macbride and having every appearance of being part of the same collection. It is certainly authentic. Our figure 144 was drawn from this specimen. Hagelstein's 1623, from New York, is in satisfactory agreement with Ellis' specimens. However, the illustration of Symphytocarpus confluens, p. 220, f. 2, in the paper by Ing and Nannenga-Bremekamp (1967) does not agree with the specimens cited, hence that name is cited above as a

doubtful synonym of the species. In view of the paucity of collections, we are not prepared to say it is not within the area of possible variation of the species.

There is real question whether the outer portion of the capillitium in our specimens constitutes a surface net comparable to that of other species of *Stemonitis*, but in view of the evident confusion, we retain the species in that genus.

Stemonitis confluens var. syncarpon Yamashiro, Jour. Sci. Hiroshima Univ. B(2). 3: 34. 1936, Text f. 5, pl. 4, f. 12–14, is described as differing from the typical form in its clustered and somewhat larger spores, 12–13 μ in diameter. It is therefore somewhat intermediate between S. uvifera Macbr. and S. confluens Cooke and Ellis. It may be a distinct species or it may indicate that all three represent variants of a single wide-spread species. The variety is known only from the type locality in Japan.

Stemonitis flavogenita Jahn, Verh. Bot. Ver. Brand. 45: 165. 1904.

Sporangia cylindric, obtuse, closely fasciculate, wood-brown at first, becoming natal-brown with the disappearance of the spores, 4–8 mm tall, occasionally taller; stalk sometimes short but not rarely exceeding one-third total height, black; columella ending abruptly just below the apex, often with a cupulate expansion at the tip; capillitium a loose network with many membranous expansions, the surface net delicate, the meshes uneven, mostly small, with many free spine-like ends, often falling away rather quickly, especially above; hypothallus membranous, varying from pallid, through dull red to nearly black; spores rich brown in mass, lilaceous brown by transmitted light, verruculose, 7–9 μ in diameter. Plasmodium yellow, pallid, or white.

TYPE LOCALITY: Germany.

HABITAT: Dead wood and plant debris.

DISTRIBUTION: Known from scattered collections, New England to Washington and south to Panama; Europe; Asia; Africa.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 119, a-d; Hattori, Myxom. Nasu pl. 20, f. 3.

As noted by Hagelstein, this is a difficult species to define, but it serves as a useful center in which to group collections which do not fit into S. splendens and other related species. G. Lister (1911, 1925) speaks of the spines on the surface net, as does Hagelstein (1944). Examination of numerous specimens suggests that the net, when intact, is not spiny, but that it is very delicately attached and falls away readily at maturity, leaving the slender tips of the capillitium to which it had been connected as free spines. Careful search will usually reveal fragments of the net in such mature sporangia. The plasmodial color, on which Jahn based the specific epithet, is also inconstant. Some collections referred to S. splendens are similar to S. flavogenita in having expanded branches of the capillitium and a tendency to expansion at the tips, but may be distinguished by the larger-meshed, persistent net and the less strongly marked spores as well as by the darker color and usually much larger size.

Stemonitis fusca Roth, Mag. Bot. Römer & Usteri 1(2): 26. 1787.

Trichia nuda With., Brit. Pl. ed. 2. 3: 477. 1792.

Stemonitis fasciculata Pers. ex Gmel., Syst. Nat. 2: 1468. 1791. Not S. fasciculata Schum. 1803.

Stemonitis maxima Schw., Trans. Am. Phil. Soc. II. 4: 260. 1832.

Stemonitis dictyospora Rost., Mon. 195. 1874.

Stemonitis castillensis Macbr., Bull. Nat. Hist. Univ. Iowa 2: 381. 1893.

FIG. 145 Plate XV

FIG. 146

Plate XV

Sporangia slender, cylindric, tufted, often in large colonies, on a brown, membranous hypothallus, 6–20 mm tall, deep fuscous varying to dark redbrown, becoming paler as the spores are shed; stalk black, shining, rather long, from nearly half the total height in the shorter fructifications to one-fourth or less in those that are taller; columella dark brown or blackish, reaching nearly or quite to the apex; capillitium arising from all parts of the columella, branching and anastomosing freely, the ultimate branchlets united into a close-meshed surface net; spores fuscous in mass, violet-brown by transmitted light prominently to delicately warted-reticulate or merely spinulose or papillate, 7.5–9 μ in diameter. Plasmodium white.

TYPE LOCALITY: Europe.
HABITAT: Dead wood.
DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 118, a,e; Macbr. & Martin, Myxom. pl. 11, f. 249, 250; Hattori, Myxom. Nasu pl. 20, f. 1; Nat. Geogr. Mag. 49(4): pl. 7 (as S. splendens).

EXSICCATI: Ellis, N. Am. Fungi 1119; Ellis & Ev., N. Am. Fungi 2697; Brândză, Myxom. Roum. I. 1: 17; 68(NY); Thaxter, Rel. Farl. 373.

The typical fruiting expression is that of rather large tufts of the graceful, dark purplish sporangia arising from a common hypothallus, the tufts occurring in groups. The reticulation of the spores is usually clearly visible under a 4 mm dry objective, but occasionally an oil immersion objective is necessary to bring it out clearly. This species is everywhere common and conspicuous and is often illustrated in elementary texts.

Persoon, Ann. Bot. Usteri 20: 120. 1796, cited S. fusca Roth, S. typhina "Gmel." and Clathrus nudus L. as synonyms of S. fasciculata Pers. He recognized S. typhina "(Willd.)" as a distinct species, citing "St. fusca Gmel. syst. Linn." as a synonym. The confusion is less, it is to be hoped, at the present time, but certainly not all the problems involved have been solved.

Of the five varieties recognized in the third edition of the Lister monograph, var. nigrescens and var. trechispora are here regarded as distinct species. The var. confluens is listed under Amaurochaete as doubtful. The var. rufescens A. Lister, Mycet. 110. 1894, with rather small spores and more reddish color than usual, is questionable. The var. flaccida G. Lister, Mycet. ed. 2. 144. 1911, has been interpreted as representing agglutinated fruitings probably developed in excessively moist conditions. However, B. Ing and Nannenga-Bremekamp, K. Ned. Akad. Wet. Proc. C. 70: 218. 1967 make it the type of their new genus Symphytocarpus, as S. flaccidus (Morgan) B. Ing & Nann.-Brem.

The var. papillosa Meylan, Bull. Soc. Vaud. Sci. Nat. 58: 322. 1935, from Japan, is described as having strongly papillate spores. Its status is uncertain. For the present it is adopted in the key to accommodate all forms of S. fusca in which the reticulations on the spores seem to be lacking.

Stemonitis herbatica Peck, Ann. Rep. N. Y. State Mus. 26: 75. 1874.

FIG. 147 Plate XVI Sporangia cylindric, obtuse, stalked or occasionally nearly sessile, natal-brown or army-brown, fading to avellaneous, in small clusters, these usually aggregated in extensive fruitings, 3–7 mm tall; stalk short, fuscous to black, only slightly expanded below; hypothallus membranous, rather inconspicuous; columella attenuate upward, sometimes not reaching the apex; capillitium brown, the inner network moderately dense, often with expanded nodes; surface net paler, the meshes small, polygonal; spores dark purplish brown in mass,

pale by transmitted light, minutely warted, 7–9 μ in diameter. Plasmodium white to pale yellow.

TYPE LOCALITY: Albany, N. Y.

HABITAT: Living herbaceous plants; less commonly on dead wood and forest debris.

DISTRIBUTION: Throughout North America; Europe; Africa; Fiji.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 120, a-g; Macbr. & Martin, Myxom. pl. 12, f. 276, 277.

EXSICCATI: Brândză, Myxom. Roum. 102, 119(NY).

In its typical form, growing on living herbaceous plants, this species is unmistakable. It is usually equally so on wood, but there, when tufted or densely aggregated, may be taken for *S. fusca*, from which the rather pale spores without trace of reticulation, distinguish it. From small fruitings of *S. splendens*, it may be distinguished by its browner color and much more delicate surface net.

Indira (1966) suggests that the reason this species is so commonly found on living plants is that the plasmodium usually occurs in soils.

The variety confluens G. Lister, Mycet. ed. 2. 148. 1911, in which the sporangia are massed in a pseudoaethalium, has been transferred to Symphytocarpus as S. herbatica B. Ing, K. Ned. Akad. Wet. Proc. C. 70: 229. 1967. The description given there suggests that it is a distinct species.

Stemonitis hyperopta Meylan, Bull. Soc. Vaud. Sci. Nat. 52: 97. 1918.

Comatricha typhina var. heterospora Rex, Proc. Acad. Phila. 45: 367. 1893. Comatricha typhoides var. heterospora (Rex) A. Lister, Mycet. 121. 1894. Comatricha hyperopta (Meylan) Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 70: 208. 1967.

Sporangia broadly cylindric or elongate-ovate, lilaceous brown, 2.5–5 mm tall, occuring in small, loose clusters; stalk short, 0.1–0.5 mm tall, continued into the slender columella; capillitium a network of slender, flexuous, brown threads, the ultimate branchlets united with the delicate surface net, which may be early fugacious above, persisting only over the lower half or two-thirds of the sporangium; spores lilac-brown in mass, pale lilac by transmitted light, warted and faintly and often incompletely banded-reticulate, 5-6(-7) μ in diameter. Plasmodium watery white.

TYPE LOCALITY: Switzerland.

HABITAT: Dead wood.

DISTRIBUTION: Europe; Maine to Washington, south to North Carolina and Iowa, possibly Texas, and in Puerto Rico; South America; Japan.

ILLUSTRATIONS: G. Lister, Mycet, ed. 3. pl. 125, d–f; Macbr. & Martin, Myxom. pl. 11, f. 253, 254; Hattori, Myxom. Nasu pl. 20, f. 6.

EXSICCATI: Brândză, Myxom. Roum. 63, 101 (NY).

The rather pale, relatively stout sporangia, the small, banded-reticulate spores and the absence of a surface net in the upper portion of mature sporangia are characteristic of this species. In many specimens, fragments of a surface net may be seen on the upper part of the sporangia, suggesting that it is formed but falls away very early with the peridium. Other species may lose the upper part of the net when weathered, and the markings on the spores are faint, hence many of the collections referred to this species may well belong elsewhere. Nannenga-Bremekamp (1967) not only transferred S. hyperopta to Comatricha, but made it the type of the new subgenus Stemonitopsis. See comments under Comatricha; here

FIG. 148 Plate XVI it need only be noted that in view of the evidence of a complete surface net in early stages of specimens which we believe are correctly assigned to the species, the transfer to *Comatricha* does not serve to clarify the admittedly difficult problems posed by this group of species.

Hagelstein (1944) gives the type locality as New York; Martin (1949) as the eastern United States. Both of these statements are based on the fact that Meylan mentions a specimen received from Sturgis, which he distinctly says is a good species, but not the same as Comatricha typhoides var. heterospora (Rex) A. Lister, which is his S. hyperopta. The references are confused, but it seems certain that Meylan's species is based fundamentally on his Swiss collections prior to 1918, one of which should be designated as the type. The removal of the small-spored specimens formerly assigned to the var. microspora (A. Lister) G. Lister to S. microsperma B. Ing has clarified the concept of this species.

Stemonitis inconspicua Nann-Brem., K. Ned. Akad. Wet. Proc. C. 69: 350. 1966.

Sporangia cylindrical, blunt, brown, 2–3 mm tall, produced in small compact clusters on a common thin hypothallus, which is brown with silvery reflections; stalk short, slender, black, usually less than one-fourth the total height, extending into the sporangium as a tapering columella attaining nearly the apex and giving rise to the rather slender capillitium; peridial net delicate, irregular, somewhat fragmentary, with many short free ends; spores dark brown in mass, pale by transmitted light, with a prominent, dark, very coarse banded reticulum of 2–4 meshes to a diameter, the body of the spores 7–8 μ , with the ridges, 8–9 μ . Plasmodium white.

TYPE LOCALITY: Doorwerth, Netherlands.

навітат: Dead oak leaves.

DISTRIBUTION: Netherlands, Great Britain.

ILLUSTRATION: K. Ned. Akad. Wet. Proc. C. 69: 351, f. 1.

The above description is slightly modified and shortened from the original on the basis of examination of a portion of the type. The general habit suggests S. trechispora, but the color is brown, not black, and the spores are quite different from those of that species. The author states the spores are red-brown by transmitted light, but that is not apparent when the KOH, glycerine method is used. The type of S. virginiensis is much more violaceous, and the spores are verrucose-reticulate, with smaller meshes.

Stemonitis microsperma B. Ing, Trans. Brit. Mycol. Soc. 48: 648. 1965.

Comatricha typhoides var. microspora A. Lister, Mycet. 121. 1894.

Comatricha microspora (A. Lister) G. Lister, Guide Brit. Mycet. ed. 4. 39. 1919.

Stemonitis hyperopta var. microspora (A. Lister) G. Lister, Mycet. ed. 3. 134. 1925. Not "S. microspora G. Lister."

Comatricha microsperma (B. Ing) Nann-Brem., K. Ned. Akad. Wet. Proc. C. 70: 208. 1967.

Sporangia cylindric, acuminate, dark lilaceous brown, 1.7–3.2 mm tall, fasciculate in small clusters; stalk dark, slender, about one-third the total height; capillitium arising from entire length of columella, which is dissipated near the tip of the sporangium; surface net delicate, complete; spores reddish brown in mass, pale by transmitted light, marked with a complete delicate reticulation, 3.2–4.5 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Lyme Regis, England.

HABITAT: Mainly dead leaves of angiosperm trees.

DISTRIBUTION: England; Germany, Czechoslovakia, Netherlands; New Jersey, Ohio.

ILLUSTRATION: Lister, Mycet. ed. 3, pl. 125, f. g, h, i (as "Stemonitis microspora G. Lister," not S. microspora A. Lister).

We have no material of this species, but A. Lister, in 1894, describing the variety cited above, said he had received a specimen from Morgan almost identical with the type. No such specimen has been found in the Morgan material at Iowa.

As noted above, Nannenga-Bremekamp (1967) has replaced this taxon in Comatricha under a new and valid name.

Stemonitis brasiliensis Farr & Martin, Broteria, ser. Cienc. Nat. 27: 156. 1958.

Stemonitis mussooriensis Martin, Thind & Sohi, Mycologia 49: 128. 1957.

Sporangia cylindrical, stipitate, short, black, 1.5–2.5(–3) mm in height and 0.2–0.3 mm wide, erect or sometimes curved, with obtuse apices, rather closely aggregated in large tufts on a shining, silvery hypothallus; stipe short, erect, jet black, one-fourth to one-third the total height, expanded at base, gradually tapering upward; peridium evanescent, irregularly dehiscent; columella a prolongation of the stipe, prominent, thick, central, black, sparsely branched, tapering gradually upward, flexuous above, ending abruptly just below the obtuse sporangial apex; columella lax, composed of branching, tapering, flattened and anastomosing violaceous brown threads, often expanded and paler at points of union, the meshes irregular, up to 130 μ in diameter, the ultimate branchlets slender and anastomosing with the surface net which has smaller meshes than those of the interior; spores black in mass, violaceous brown by

transmitted light, profusely and prominently spiny-warted, 10.5–12.5 μ in diameter including the slender warts which may be as much as 0.8 μ in height.

TYPE LOCALITY: Mussoorie, India.

HABITAT: Dead wood and encrusting live plants.

DISTRIBUTION: India: Brazil.

Plasmodium unknown.

ILLUSTRATIONS: Mycologia 49: 129, f. 1; Broteria, ser. Cienc. Nat. 27: 157, f. 2.

The flattened capillitial branches, the large, conspicuously marked spores, the short, erect sporangia and the lack of coppery tints distinguish this species. Whether to call the markings on the spores warts or spines is difficult to decide. They are somewhat long for warts and rather blunt for spines.

In view of its almost simultaneous discovery in two such widely separated localities as India and Brazil, the specific epithets applied are peculiarly unfortunate. See Farr, Mycologia 51: 598. [1959] 1960.

Stemonitis nigrescens Rex, Proc. Acad. Phila. 43: 392. 1891.

Stemonitis fusca var. nigrescens (Rex) Torrend, Broteria 7: 81. 1908.

Sporangia gregarious, usually in small, dense clusters upon a common hypothallus, erect, cylindric, stipitate, 2–5 mm tall, black, becoming fuscous after the spores are shed; stalk black, short, 0.1–0.5 mm long; columella reaching nearly to the apex, black, giving rise to the dense capillitium; net small-

FIG. 149 Plate XVI

FIG. 150 Plate XVI meshed, sometimes incomplete or disappearing early in the upper portion; spores black in mass, violet-brown by transmitted light, conspicuously spiny, the spines arranged in a small-meshed, reticulate pattern, 8–9 μ in diameter. Plasmodium yellowish green.

TYPE LOCALITY: Philadelphia, Pa.

HABITAT: Wood and bark, less commonly leaves and plant litter.

DISTRIBUTION: Known from widely scattered localities, from Pennsylvania to California, south to North Carolina, Louisiana, Texas, and Arizona; Jamaica; Wales; Queensland.

G. Lister (1924) and Hagelstein (1944) both regard this as a variety of S. fusca. The small clusters of short-stemmed, very dark sporangia with larger and more strongly marked spores than in S. fusca seem quite distinct and constant.

FIG. 151 Plate XVI Stemonitis pallida Wingate, in Macbr., N. Am. Slime-Moulds 123. 1899. Stemonitis carolinensis Macbr., N. Am. Slime-Moulds 122. 1899.

Sporangia gregarious in large groups, often broken up into small clusters within the colony, stipitate, erect, cylindric, rather slender, somewhat obtuse, 2-6(-7.5) mm tall, dusky drab, becoming pallid as the spores disappear; stalk of medium length, one-third the total height or a little more, black, polished, rising from a thin, brown or iridescent hypothallus; columella percurrent, ceasing abruptly at the apex or dispersed below; capillitium dense, the tips fusing with the close-meshed surface net which tends to be fugacious above, spores dark brown in mass, pale lilaceous by transmitted light, minutely punctate, (6-)6.5-7.5(-8) μ in diameter; plasmodium white or greenish yellow.

TYPE LOCALITY: Delaware County, Pennsylvania.

HABITAT: Dead wood.

DISTRIBUTION: Eastern United States to Iowa; Europe; the Malay Peninsula; Iapan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 120, h-l; Hattori, Myxom. Nasu pl. 20, f. 2.

EXSICCATI: Ellis & Ev., N. Am. Fungi 3498 (Type).

Stemonitis carolinensis is here cited as a synonym in harmony with the treatment in the Lister and Hagelstein monographs. Both cite "S. tenerrima Morgan" as an additional synonym. Morgan referred American specimens to S. tenerrima "B. & C.", here called Comatricha tenerrima (M. A. Curt.) G. Lister. "S. tenerrima Morgan" was never validly published. Miss Lister's citation means no more than that in her opinion Morgan's specimens were incorrectly identified.

S. carolinensis and S. pallida were published simultaneously, but since both G. Lister and Hagelstein have used the latter name, it is the valid one if the two are regarded as synonyms.

Stemonitis smithii Macbr., Bull. Nat. Hist. Univ. Iowa 2: 381. 1893.

FIG. 152 Plate XVI Stemonitis microspora A. Lister, in Morgan, Jour. Cinc. Soc. Nat. Hist. 16: 138. 1894, in part.

Stemonitis ferruginea var. violacea Meylan, Bull. Soc. Bot. Genève 2: 264. 1910.

Stemonitis ferruginea var. smithii (Macbr.) G. Lister, Mycet. ed. 2. 150. 1911. Stemonitis axifera var. smithii (Macbr.) Hagelst., Mycet. N. Am. 154. 1945.

Sporangia in small, close-packed clusters, subcylindric, tapering to base and tip, erect, light cinnamon-drab to vinaceous fawn, 2.5–6 mm tall; stalk jet black, shining, about two-fifths the total height; columella dark, becoming brown at the tip, gradually tapering and becoming dissolved into the capillitium some distance below the apex; capillitium abundant, light brown, the threads of the interior sparingly united; surface net delicate, the meshes small, regular, polygonal; hypothallus thin, distinct, common to a cluster; spores bright reddish brown in mass, pale brown or almost colorless by transmitted light, nearly smooth, 4–5 μ in diameter. Plasmodium greenish yellow to reddish purple.

TYPE LOCALITY: San Carlos, Nicaragua.

HABITAT: Dead wood.

DISTRIBUTION: Temperate and tropical North America to Panama; Jamaica; Europe; Asia; New Zealand.

ILLUSTRATIONS: Bull. Nat. Hist. Iowa 2, pl. 10, f. 4; Macbr. & Martin, Myxom. pl. 12, f. 268, 269.

Distinguished from S. axifera by the smaller spores, the more delicate capillitium and net and the usually smaller size and smaller clusters. It is certainly close to that species and varietal status may be all that is justified in this case. We have seen no specimens of S. ferruginea var. violacea, but the spore size given in the description is $4-6~\mu$, suggesting this species rather than S. microsperma. The color is compared with that of Comatricha typhoides, which might apply to somewhat aberrant forms of either species.

Stemonitis splendens Rost., Mon. 195. 1874.

Stemonitis morganii Peck, Bot. Gaz. 5: 33. 1880.

Stemonitis baeuerlinii f. fenestrata Rex, Proc. Acad. Phila. 42: 37. 1890.

Stemonitis webberi Rex, Proc. Acad. Phila. 43: 390. 1891.

Stemonitis acuminata Massee, Mon. 78. 1892.

Stemonitis baeuerlinii Massee, Mon. 79. 1892.

Stemonitis splendens var. flaccida A. Lister, Mycet. 112. 1894.

Comatricha flaccida (A. Lister) Morgan, Jour. Cinc. Soc. Nat. Hist. 16: 135. 1894.

Stemonitis splendens var. webberi A. Lister, Mycet. 112. 1894.

Stemonitis fenestrata (Rex) Macbr., N. Am. Slime-Moulds 119. 1899.

Sporangia cylindrical, deep purplish brown to black, (5-)7-15(-25) mm tall, obtuse, rigid and more or less erect in the shorter colonies, ranging to flexuose and acuminate in the longer fruitings, often forming very large and conspicuous clusters, sometimes agglutinated; stalk black, polished, 1–4 mm tall, arising from a widely expanded, silvery or somewhat purplish hypothallus; columella reaching nearly to the apex, often coiled and tortuous toward the tip; capillitium brown, often with notable coppery or bronze iridescence, arising from the columella by relatively few branches, the meshes open and the tips united with the large-meshed surface net, the meshes irregular and mostly (10-)20-100(-125) μ in diameter, the net incomplete or lacking in agglutinated fruitings; spores purplish black in mass, yellowish or lilaceous brown by transmitted light; faintly, rarely prominently, warted, 7–9 μ in diameter. Plasmodium pale yellow or white.

TYPE LOCALITY: Europe.

HABITAT: Dead wood, usually large fallen logs.

Plate XVI

FIG. 153

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 121, f. a-i; Macbr. & Martin, Myxom. pl. 11, f. 260-265, pl. 12, f. 284, 285; Hattori, Myxom. Nasu pl. 20, f. 4.

After examination of many specimens referred to this species and to S. webberi, we have found complete intergradation in all respects and do not find any clear separation between them and the typical form or S. webberi. The variety flaccida A. Lister, changed to Comatricha flaccida (A. Lister) Morgan, appears to represent, as both Lister and Hagelstein say, a recumbent form, in which the sporangia are matted together and the surface net almost or entirely suppressed. Here again, the varietal name seems unnecessary, since these appearances may be explained by environmental conditions during maturation or, in some cases, by weathering after it, and do not, therefore, represent any constant and inherent differences from the standard species.

As here defined, Stemonitis splendens is an extremely variable species, very distinctive in its typical expression as large clusters of dark, slender, closely appressed, drooping sporangia on a broadly expanded silvery white hypothallus, but merging into smaller clusters on a less conspicuous hypothallus, and then more erect. Some of these suggest S. fusca, differing only in their more reddish color and, under the lens, in the large meshes of the surface net and in the lack of any trace of reticulation on the spores. The named varieties are impossible to separate with any practical degree of precision.

FIG. 154 Plate XVII , Stemonitis trechispora (Berk.) Macbr., N. Am. Slime-Moulds ed. 2. 159. 1922. Stemonitis fusca var. trechispora Berk. ex Torrend, Broteria 7: 81. 1908.

Symphytocarpus trechisporus (Berk.) Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 70: 219. 1967.

Sporangia small, nearly black, irregular, sessile or nearly so, densely clustered, sometimes appearing connate below, free above, 3–7 mm tall; stalk, when present, black, very short, occasionally to 1 mm high; columella black, slender, usually tortuous, not reaching the apex; capillitium usually open, irregular; surface net irregular, developed mainly above; spores black in mass, purple-brown by transmitted light, prominently but irregularly and often incompletely reticulate with raised bands, spiny where not reticulate, 11–13 μ in diameter, including border. Plasmodium white.

TYPE LOCALITY: Venezuela.

HABITAT: Leaves, mosses and twigs in wet areas.

DISTRIBUTION: Maine to Virginia and Washington; South America; Europe; Asia.

ILLUSTRATIONS: Macbr., N. Am. Slime-Moulds ed. 2. pl. 20, f. 11; Ber. Deuts. Bot. Ges. 41: 394, f. 1, a-c; K. Ned. Acad. Wet. Proc. C. 70: 221, f. 3.

This species is characterized by the small tufts of very dark, short, nearly cylindrical, sessile or short-stalked sporangia, the very open net and the large, strongly marked, reticulate spores. G. Lister (1925) regarded it as no more than a poorly defined variety of S. fusca. There can be no doubt that small and poorly developed fruitings of S. fusca have been determined as S. trechispora but the latter species differs from S. fusca in habit, color, net and spores and is constant and distinct in collections from widely separated localities. Hagelstein (1944) recognized the species and his collections are typical although he gives the spore range as 9-12 μ . He cites Amaurochaete trechispora Macbr. & Martin as a synonym. Torrend, in publishing Berkeley's name, said "Spores fortement réticulés, à rebord de

près de 1 μ ., de 10–12 μ de diam." and Nannenga-Bremekamp (1966, p. 352) restricted S. trechispora to forms with spores 11–13 μ in diameter. The addition of the border to Torrend's figures brings them into agreement with the latter figures.

Stemonitis uvifera Macbr., N. Am. Slime-Moulds ed. 2. 161. 1922.

Sporangia slender, cylindric, more or less recumbent, deep fuscous, 7–9 mm tall, in rather dense clusters, sometimes forming a pseudoaethalium; stalk black, polished, one-fourth to one-third the total height; columella dark, marked by obscure spirals, not attaining the apex; capillitium dark, with coppery or bronze iridescence, of stout branches, often flattened into membranous expansions in the axils; surface net irregular, with many large meshes and free ends; spores nearly black in mass, pale sooty brown by transmitted light, firmly united in clusters of 4–12 or more and often irregular in shape from pressure, the exposed surface distinctly warted, the rest smooth, occasionally free, and then globose and more uniformly warted, 8–10 μ in diameter. Plasmodium white before fruiting.

FIG. 155 Plate XVII

TYPE LOCALITY: Mt. Rainier, Washington.

HABITAT: Dead wood.

DISTRIBUTION: Pennsylvania, District of Columbia, Ohio, Iowa, Montana, Washington.

ILLUSTRATIONS: Macbr. & Martin, Myxom. pl. 11, f. 257-259.

Both Lister (1925) and Hagelstein (1944) regard this as a dubious species. Certainly some of the collections which have been referred to it belong elsewhere, but we have ample material to justify maintaining it as specifically distinct.

As noted under S. confluens, Yamashiro has described from Japan a variety of that species with the typical disk-like membrane uniting the capillitia of adjacent sporangia characteristic of that species but with clustered spores, known only from the type locality. That is the only other Stemonitis with clustered spores. A collection from Iowa City shows continuous variation from clusters of separate sporangia to pseudoaethalia, in which the sporangia, while separate below, are covered by a continuous crust above.

Stemonitis virginiensis Rex, Proc. Acad. Phila. 43: 391. 1891.

Sporangia cylindric or elongate-ovate, blunt or slightly acuminate above, violaceous-brown, 2–6(–8) mm tall, gregarious in small clusters on a common hypothallus; stalk black, shining, 0.5–2 mm tall, one-fourth to one-third the total height; columella reaching the apex, giving rise to a delicate capillitium, the ultimate branches united with the small-meshed surface net which tends to fall away above; spores bright in mass, pale lilac-brown by transmitted light, marked by a sharp reticulation of narrow bands connecting prominent warts, (5.5-)6-7(-8) μ in diameter. Plasmodium unknown.

FIG. 156 Plate XVII

TYPE LOCALITY: Mountain Lake, Virginia.

HABITAT: Dead wood.

DISTRIBUTION: Widely but sparsely distributed in the United States and reported from Europe.

ILLUSTRATIONS: Macbr. & Martin, Myxom. pl. 11, f. 251, 252.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2896 (Type).

The small clusters of dark lilaceous sporangia and the strongly marked, verrucose-reticulate and small, rather pale spores mark this rare species.

Both the Lister and Hagelstein monographs speak of the spores as bandedreticulate. In the type, the verrucose-reticulate character of the spores is well displayed. Both speak of the surface net as usually lacking in the upper part of the sporangium. This is true of other species of *Stemonitis* but in most such cases, as in this, there is evidence that it is merely more delicate above and falls away more rapidly.

In addition to the type distributed as E. & E., 2896, we have a specimen sent by Rex to Morgan which appears to be part of the type collection and one from North Carolina sent by Rex to Wingate, also specimens from New Hampshire, Indiana and Maryland which appear to belong here. Other collections so labelled are less satisfactory and some, at least, may be small examples of other species. We have seen no European material.

ADDITIONAL SPECIES

Symphytocarpus amaurochaetoides Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 70: 220, f. 4. 1967.

Dark, densely clustered, approaching a pseudoaethalium in the very irregular columellae, which may be lacking, and in the lack of a surface net; the spores spinose-reticulate, the meshes prominent, 8-9(-10) μ . Plasmodium white. Reported from the Netherlands and Sweden.

Symphytocarpus cristatus Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 70: 224, f. 5. 1967.

Close to Symph. amaurochaetoides, from which it differs chiefly in its spores, which are conspicuously banded, the bands tending to be united into a very openmeshed, broken reticulation, $(8-)9-10(-11)~\mu$. Known only from the type collection, Netherlands.

Symphytocarpus impexus B. Ing & Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 70: 227, f. 6. 1967.

Close to Stemonitis confluens Cke. & Ell. (Symph. confluens (Cke. & Ell.) B. Ing & Nann.-Brem.), from which it differs in its more elongate sporangia with distinct but irregular columellae, and its smaller spores, 8–9 μ . Known from Netherlands and England.

EXCLUDED AND DOUBTFUL SPECIES

Stemonitis alba Schrank, Baier. Fl. 2: 635. 1789. (as Stemionitis).

Neither description nor comments permit identification. Certainly not S. alba (Bull.) J. F. Gmel.

Stemonitis carnea Schrank, Baier. Fl. 2: 634. 1789. (as Stemionitis).

Probably a mold, G. Lister, Mycet. ed. 3. 261.

Stemonitis coccinea (Bull.) J. F. Gmel., Syst. Nat. 1468. 1791.

Based on Sphaerocarpus coccineus Bull., Hist. Champ. Fr. 126. 1791, pl. 368, f. 1 (1787). Cited by G. Lister, Mycet. ed. 3. 230, as possible synonym of Arcyria incarnata. Certainly not a Stemonitis in current usage.

Stemonitis curitibensis Hertel, Dusenia 6: 47. 1955.

Said to be close to S. splendens. The description suggests that it is well within the possible limits of variation in that species.

Stemonitis cyathiformis Schrank, Mag. Bot. Römer & Usteri 4(12): 19. 1790.

Cited by G. Lister, Mycet. ed. 3. 78, as a possible synonym of Craterium leucocephalum.

Stemonitis decipiens T. F. L. Nees, Acta Acad. Car. Leop. 16: 95. 1820.

Cited by G. Lister, ed. 3. 137, as a possible synonym of S. herbatica.

Stemonitis fascicularis Eaton, Man. Bot. ed. 3: 480. 1822.

Attributed to Persoon in preface. Probably an error for S. fasciculata Pers.

Stemonitis filicina Schrank, Baier. Fl. 2: 634. 1789. (as Stemionitis).

Cited by Berlese in Sacc., Syll. 7: 395 as a synonym of Comatricha typhina (Roth) Rost. Based on S. petiolata gregaria Gled., Meth. Fung. pl. 4, redrawn from Micheli, pl. 94. Could include several species.

Stemonitis fluminensis Speg., Ann. Soc. Ci. Arg. 12: 255. 1881.

"Doubtful, evidently . . . ill-developed," Lister, Mycet. ed. 3. 261.

Stemonitis fulva J. F. Gmel., Syst. Nat. 1468. 1791.

"Doubtful." Lister, Mycet. ed. 3. 261.

Stemonitis fulvipes Fries, Fungi Natal. 33. 1848.

Cited by Berlese in Sacc., Syll. 7: 345 as a synonym of *Physarum flavicomum* Berk.

Stemonitis furfuracea J. F. Gmel., Syst. Nat. 1468. 1791. "Doubtful." Lister, Mycet. ed. 3. 261.

Stemonitis globosa Trent., in Roth, Cat. Bot. 1: 222. 1797.

Cited by G. Lister, Mycet. ed. 3. 237 as a doubtful synonym of Arcyria incarnata.

Stemonitis globosa Schum., Enum. Pl. Saell. 2: 217. 1803.

Cited by G. Lister, Mycet. ed. 3. 141, as a possible synonym of Comatricha nigra.

Stemonitis globularis J. F. Gmel., Syst. Nat. 1470. 1791.

Based on Sphaerocarpus sessilis Bull., Hist. Champ. Fr. 132. 1791, pl. 417, f. 5. Suggests a Perichaena.

Stemonitis graniformis (Hoffm.) J. F. Gmel., Syst. Nat. 1468. 1791.

Based on Trichia graniformis Hoffm., Veg. Crypt. 2, pl. 1, f. 2. 1790. "Doubtful." Lister, Mycet. ed. 3. 261.

Stemonitis heterospora Oudem., Ned. Kr. Arch. I. 167.

Cited by Berlese in Sacc., Syll. 7: 398, as synonym of S. ferruginea Ehr. Reference not traced (Arch. Neerl. Sci. I. 1: 167. 1866?).

Stemonitis lilacina Schrank, Baier, Fl. 2: 635. 1789. (as Stemionitis).

Cited by Berlese in Sacc., Syll. 7: 428, as synonym of Arcyria adnata (A. incarnata).

G. Lister, Mycet. ed. 3. 261 writes "doubtful."

Stemonitis morthieri Fuckel, Nass. Ver. Naturk. 23-24: 339. 1870.

Cited as synonym of Lamproderma arcyrioides by Berlese in Sacc., Syll. 7: 393; of L. violaceum var. sauteri by G. Lister, Mycet. ed. 3. 157. Scarcely L. sauteri as here treated.

Stemonitis nivea (Hoffm.) J. F. Gmel., Syst. Nat. 1467. 1791.

Gmelin cites *Trichia nivea* Hoffm., Veg. Crypt. 2: 14, pl. 4, f. 1. 1790, which could be a pale *Arcyria*.

"Stemonitis pumila Corda," Ic. Fung. 5: 59, pl. 3, f. 57. 1842.

Cited by Rostafinski, Mon. 198. 1874, as a synonym of *Comatricha typhina*, "p.p." in index, and copied by later authors. Neither the illustration nor the description justify this. Corda made no such combination. He believed, with some reservation, he was dealing with S. *pumila* Fries.

Stemonitis pumila Fries, Syst. Myc. 3: 159. 1829.

Identity uncertain. Rostafinski, Mon. 292. 1875 (index), says "p.p." Stemonitis fusca. Doubtful.

Stemonitis pyriformis (Bull.) J. F. Gmel., Syst. Nat. 1469. 1791.

Based on *Sphaerocarpus piriformis* Bull., which is cited by Berlese, in Sacc., Syll. 7: 447, as a synonym of *Hemiarcyria clavata*. The same combination was used earlier by Willdenow in 1787 and by Roth in 1788 and all are sometimes spelled *piriformis* by later authors. The name can legitimately be regarded as a cause of confusion.

Stemonitis recutita (L.) J. F. Gmel., Syst. Nat. 1467. 1791.

Gmelin cites Clathrus recutitus L., Syst. Nat. ed. 12. 2: 724. 1767. Berlese, in Sacc., Syll. 7: 427. 1888, cites S. recutita Gmel. as a synonym of A. cinerea.

Stemonitis reticulata Trent., in Roth, Cat. Bot. 1: 223. 1797.

Cited by Berlese, in Sacc., Syll. 7: 395, as a possible synonym of Comatricha friesiana (C. nigra).

Stemonitis sphaerocarpa Schrank, Mag. Bot. Römer & Usteri 4(12): 20. 1790.

Cited by Berlese, in Sacc., Syll. 7: 416, as synonym of Cribraria argillacea.

Stemonitis subclavata Zoll., Flora 30: 301. 1847.

Cited by G. Lister, Mycet. ed. 3. 139, as possible synonym of S. smithii.

Stemonitis sulphurea Roth, Fl. Germ. 1: 548. 1788.

A fungus, Eurotium, according to G. Lister, Mycet. ed. 3. 261.

Stemonitis travancorensis Erady, Kew Bull. 1953: 570, 1953.

Said to differ from S. fusca in its yellow plasmodium, spiny spores and particularly in its parasitism on a cactus. The description suggests it is very close to S. splendens and possibly to be included in that species.

Stemonitis trichia Roth, Fl. Germ. 1: 549. 1788.

Cited by G. Lister, Mycet. ed. 3. 237, as possible synonym of Arcyria incarnata. Very doubtful.

Stemonitis typhina "Roth," Fl. Germ. 1: 549. 1788.

Roth cites Wiggers 1780 and Willdenow 1787 as using this combination. Rostafinski (1874) cited Roth as the author when he proposed the combination *Comatricha typhina* (Roth) Rost., and this has been used extensively. Willdenow also cited Wiggers, in spite of which Berlese, in Sacc., Syll. 7: 398, cited S. typhina "Willd." as a synonym of S. ferruginea.

Stemonitis vesiculosa (Batsch) J. F. Gmel., Syst. Nat. 1470. 1791.

Based on Lycoperdon vesiculosum Batsch, Elench. Fung. Cont. 1: 253. 1786. Probably a Trichia, perhaps T. varia.

Stemonitis violacea Roth, Fl. Germ. 1: 548. 1788.

The brief description suggests something having the general aspect of *Diderma hemisphaericum*, but it certainly should not be regarded as a synonym of that species.

Clastoderma

Blytt, Bot. Zeit. 38: 343. 1880.

Orthotricha Wingate, Jour. Myc. 2: 125. 1886. Not Orthotrichium Hedw. 1789.

Wingina Kuntze, Rev. Gen. Pl. 1: 875. 1891.

Sporangiate, globose, stipitate; peridium breaking up at maturity into rounded or angular fragments which remain attached to the tips of the capillitium; columella short, or lacking; capillitium, arising from the apex of the columella or the base of the sporangium, of branching and anastomosing threads bearing at the free tips the peridial platelets; spores brown.

Type species, Clastoderma debaryanum Blytt.

A single species.

Nannenga-Bremekamp, K. Ned. Ak. Wet. C. 71: 44. 1968, has described a second species of *Clastoderma*, *C. pachypus* which differs from *C. debaryanum* in the much thicker stalk and the somewhat longer columella. How constant these characters are remains to be determined.

Developmental studies by McManus (1961) and by Alexopoulos (1969) show that the development of the sporangium is not like that of any member of the Stemonitales. On the basis of the type of development, the stalk characters, and the nature of the plasmodium, Alexopoulos (1969) advocates the transfer of Clastoderma from the Stemonitaceae to the Echinosteliaceae (Order Echinosteliales). Such transfer would necessitate a slight broadening of the description of the Echinosteliales.

Clastoderma debaryanum Blytt, Bot. Zeit. 38: 343. 1880.

Orthotricha microcephala Wingate, Jour. Myc. 2: 125. 1886.

Wingina microcephala (Wingate) Kuntze, Rev. Gen. Pl. 1: 875. 1891.

Sporangia scattered or gregarious, 0.1–0.2 mm in diameter, 1–1.3 mm tall; peridium rosaceous-brown, dehiscent into scales which remain attached to the tips of the capillitium; columella short or nearly obsolete, giving rise at the tip

FIG. 184 Plate XX to the branching and occasionally anastomosing, pale brown capillitium, the latter often rather sparse; stalk slender, stuffed with dark, granular material below, translucent and brown above, the two portions usually abruptly divided by a prominent oval swelling; spores bright rosaceous-brown in mass, pallid by transmitted light, covered by very blunt, coarse warts, 8–10 μ in diameter. Protoplasmodia watery white, then greenish, becoming blackish with age and each giving rise to a single sporangium.

TYPE LOCALITY: Norway.

HABITAT: Dead wood, bark of living and dead trees, weathered sporophores of fungi, and miscellaneous debris.

DISTRIBUTION: Europe; Maine to Iowa and Panama; South America; southern Asia; Australia; abundant in the tropics.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 135; Macbr. & Martin, Myxom. pl. 21, f. 554; Hattori, Myxom. Nasu pl. 8, f. 5.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2498; Thaxter, Rel. Farl. 801.

This common and widely distributed species might well be regarded as cosmopolitan. It is very inconspicuous in the field and the majority of our specimens have been developed in moist chambers. There is some variation in the platelets, these sometimes rather scantily, sometimes very strikingly developed and the characteristic swellings on the stems vary in the same way. Those which are poorly developed in both ways approach very closely some of the smaller species of *Comatricha*, such as *C. elegans*, but the stalk character is distinct.

The var. imperatoria Emoto, Bot. Mag. Tokyo 43: 169. 1929, is said to be characterized by distinct nets on the platelets. It has been recognized only from Japan. Appearances similar to those illustrated by Emoto have been observed on some of our specimens.

Barbeyella

Meylan, Bull. Soc. Bot. Genève II. 6: 89. 1914.

Sporangiate, stipitate, columellate. Sporangium globose, dehiscent by petaloid lobes. Stalk dark, filled with dark granules. Columella an extension of the stalk, giving rise at apex to 7–10 simple or sparsely branched capillitial threads, one or two to a lobe. Spores dark.

Type species, Barbeyella minutissima Meylan.

A single species.

Barbeyella minutissima Meylan, Bull. Soc. Bot. Genève II. 6: 89. 1914.

Extremely minute; sporangia globose, 0.1–0.2 mm in diameter, violaceous to brownish black, somewhat shining, peridium impregnated above with dark granules, these fewer below, dehiscing by 5–9 lobes; stalk blackish brown, 0.3–0.7 mm long, extending as a columella into the middle of the sporangial cavity and there giving rise to 7–10 simple or rarely branched capillitial threads, one or occasionally two to each lobe of the peridium; spores brown, warted to nearly smooth, 7–9 μ in diameter. Plasmodium in the form of colorless droplets (protoplasmodia?), becoming white, then dark brown before fruiting.

TYPE LOCALITY: Chasseron, Swiss Alps.

HABITAT: On decaying logs associated with mosses, liverworts and algae.

FIG. 185 Plate XX DISTRIBUTION: Oregon; Switzerland, Sweden, Poland; Japan. ILLUSTRATIONS: Bull., Soc. Bot. Genève II. 6: 90, f. 1–6; Lister, Mycet. ed. 3, pl. 217, f. d–g.

This extremely minute species resembles *Licea operculata*, as noted by the author, but differs, not only in lack of a lid, but in the presence of a columella and a scanty, but distinct capillitium. The color, as noted by G. Lister, is that of a *Lamproderma*; the columella, with capillitium originating at the tip, and the firm peridium also suggest relationship with that genus. Jarocki (1931) reported findin it in numerous localities in eastern Poland, in damp situations on the under surface of decaying spruce logs. The description of the plasmodial stage is based on his account; he also describes its development. Emoto (1933) reported it from Japan, and Curtis (1968) from Oregon.

Macbrideola

H. C. Gilbert, Univ. Iowa Stud. Nat. Hist. 16: 155. 1934, emend. Alexop., Mycologia 59: 112. 1967.

Paradiacheopsis Hertel, Dusenia 5: 191. 1954, p.p.

Sporangia typically minute, stipitate; peridium membranous, translucent, early evanescent or persistent; stipe hollow, tubular, typically translucent, often with a yellow base, extending into the sporangium as a columella; capillitium present or absent, when present, varying from a few short branches of the columella to a very open globose net, usually rising from the tip of the columella, occasionally from the side; spores dark in mass, pallid, brown or violet-brown by transmitted light.

Type species, Macbrideola scintillans H. C. Gilbert.

As emended, *Macbrideola* permits the inclusion of several small species with scanty capillitium and hollow stalks formerly included in *Comatricha*. We believe that such modification makes both genera more homogeneous.

KEY TO SPECIES

a. Peridium persistent.

M. scintillans

a. Peridium fugacious at an early stage.

 Capillitium forming an open net with few or no free ends; spores united in clusters.

M. synsporos

 Capillitium consisting of simple or branched strands with few or no anastomoses, sometimes lacking; spores free.

c. Capillitium of robust strands which remain stout to periphery; base of peridium tending to persist as a collar.

M. cornea

 Capillitium of more or less flexuous strands which become attenuated toward the periphery.

d

b

С

d. Spores minutely and uniformly warted,
 8.5–9.5 μ; capillitium sometimes
 reduced to one or two
 short branches of the columella, or lacking.

M. decapillata

d. Spores minutely warted with scattered clusters of larger warts, 6.5–7 μ; capillitium of 3 or 4 branching threads. M. martinii

Macbrideola cornea (G. Lister & Cran) Alexop., Mycologia 59: 112. 1967.
Comatricha cornea G. Lister & Cran, in G. Lister, Jour. Bot. 55: 121. 1917.
Paradiacheopsis cornea (G. Lister & Cran) Hertel, Dusenia 7: 348. 1956.
Sporangia scattered or solitary, stipitate, globose, dark brown, 0.12-0.3

mm in diameter, their total height 0.6–2.5 mm; stalk straight, slender, subulate, translucent, clear brownish yellow below, darker above, composed of numerous interlacing strands, arising from a discoid hypothallus; columella brown, cylindric, attaining one-third to one-half the height of the sporangium, with a small collar where it meets the stalk, dividing above into the two or three primary branches of the capillitium; capillitium of dichotomously forking branches terminating in short, rigid, diverging branchlets; spores yellowish gray, the wall thinner and paler on one side, minutely warted, 8.5–9 μ in diameter. Plasmodium colorless.

TYPE LOCALITY: Aberdeen, Scotland.

HABITAT: On bark and mosses.

DISTRIBUTION: Scotland, France, Belgium, Netherlands, Germany, Switzerland, Greece; Kentucky; California.

ILLUSTRATIONS: Jour. Bot. **55**, pl. 548, f. 1; Lister, Mycet. ed. 3. pl. 210, a-e; Mycologia **59**: 109, f. 17-20.

This species has been reported from Kansas (Hagelstein, 1944) and similar specimens have been collected in other states and referred to this species, but all such that have been examined appear to belong elsewhere. Specimens agreeing with Lister's description have been collected in North America, so far as our material shows, only in Kentucky and California.

Macbrideola decapillata H. C. Gilbert, Univ. Iowa Stud. Nat. Hist. 16: 158. 1934, emend. Alexop., Mycologia 59: 113. 1967.

Sporangia widely scattered, stipitate, globose, dark brown, 50–100 μ in diameter; stalk slender, translucent, appearing hollow, yellow at the base, brown above, 125–250 μ long, continuing into the sporangium as a columella; total height 175–350 μ ; peridium very thin, hyaline, early evanescent, leaving a ring about the stipe; columella reaching one-half to three-quarters the height of the sporangium, rounded at the tip, or bearing a few short protuberances or capillitial filaments; capillitium varying from none to sparse, the threads becoming attenuated toward the periphery; spores globose, agglutinated, dark brown in mass, violaceous brown by transmitted light, thick-walled, marked with irregularly distributed warts, 7–9 μ in diameter. Aphanoplasmodium colorless.

TYPE LOCALITY: Waverly, Iowa.

HABITAT: Bark from living deciduous trees in moist chambers.

DISTRIBUTION: Florida, Michigan, Illinois, Minnesota, Iowa, Kansas, Texas; Costa Rica.

ILLUSTRATIONS: Univ. Iowa Stud. Nat. Hist. 16: 158; Mycologia 59: 108, f. 6–14; 109, f. 15–16.

Distinguished from *M. scintillans* by the relatively longer stalk, the fugacious peridium, the very rudimentary capillitium or absence of one, and the dull spore mass which is quickly dispersed leaving only the almost indistiguishable stalk and columella. As emended by Alexopoulos, this species now includes forms previously referred to *Comatricha cornea*, as illustrated in Fig. 161.

FIG. 161
Plate XVII

FIG. 182 Plate XX FIG. 170 Plate XVIII Macbrideola martinii (Alexop. & Beneke) Alexop., Mycologia 59: 114. 1967. Comatricha martinii Alexop. & Beneke, Mycologia 46: 245. 1954.

Paradiacheopsis martinii (Alexop. & Beneke) Hertel, Dusenia 7: 348. 1956.

Sporangia scattered or solitary, brown, globose, stipitate, minute, 0.08–0.15 mm in diameter, their total height 0.5–0.6 mm; peridium completely evanescent; stalk slender, brown, somewhat paler below, tapering upward, and continuing to the middle of the sporangium as a columella; capillitium lax, arising from the tip of the columella, consisting of three or four slender, brown branches which fork dichotomously three or four times with no anastomoses; spores brown in mass, violet-gray by transmitted light, minutely verrucose, bearing scattered, prominent clusters of warts, 7–8 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Jamaica.

HABITAT: Dead bark. Developed in moist chamber.

DISTRIBUTION: Jamaica, Dominica; Kentucky. ILLUSTRATION: Mycologia 46: 247, f. 1, 2.

Distinguished from M. cornea by the slender tips of the capillitium and from it and the capillitial forms of M. decapillata by the clusters of dark warts on the spores.

FIG. 183 *Plate* XX

FIG. 179

Plate XIX

Macbrideola scintillans H. C. Gilbert, Univ. Iowa Stud. Nat. Hist. 16: 156. 1934.

Sporangia scattered, stipitate, globose, dark brown or metallic bronze, 75–125 μ in diameter; stalk tapering, translucent, appearing hollow, yellow at the base, brown above, 50–100 μ in height, continuing into the sporangium as a columella; total height 125–225 μ ; peridium thin, shining, translucent, tough, persistent; columella tapering, sometimes forking at the apex, where it is strongly attached to the peridium by the tip or branches; capillitium scanty, usually represented only by the apical branches arising from the columella or occasionally from the sides; spores globose, dull brown, marked with large, irregularly distributed warts, 8–9 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Amana, Iowa.

HABITAT: Bark from living deciduous trees, in moist chambers.

DISTRIBUTION: Illinois, Mississippi, Minnesota, Iowa, Kansas, Texas.

ILLUSTRATIONS: Univ. Iowa Stud. Nat. Hist. 16: 157.

Distinguished from M. decapillata by the larger size, the shorter stalk, and the persistent, shining peridium.

In the original description, the type locality is given as Iowa City. Dr. Gilbert, in correspondence, later corrected this to Amana. We now have collections from four widely scattered localities in eastern Iowa, including one from near Iowa City.

Macbrideola synsporos (Alexop.) Alexop., Mycologia 59: 115. 1967.

Comatricha synsporos Alexop., Mycologia 50: 54. 1958.

Paradiacheopsis synsporos (Alexop.) Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 70: 209. 1967.

Sporangia stalked, scattered or solitary, dark brown, globose, 0.25 mm in diameter, total height 0.35-0.5 mm; peridium completely evanescent; stalk

pale at expanded base, tapering upward and continuing into the middle of the sporangium as a columella; capillitium lax, arising from the tip and sides of the columella, branching and anastomosing to form a globose net with a few free ends; spores in compact clusters of 7–15, brown, pyriform, coarsely warted on the exposed area, elsewhere smooth, 9.5–10.5 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Rhodes, Greece.

HABITAT: On bark of Ceratonia in moist chamber.

DISTRIBUTION: Greece; Missouri.

ILLUSTRATION: Mycologia 50: 53, f. 2, 3.

This is the only Machrideola with clustered spores.

Lamproderma

Rost., Versuch 7. 1873.

Fructification sporangiate, globose or ellipsoid to subcylindrical or fusoid, stalked or sessile on a constricted base, rarely pulvinate or plasmodiocarpous. Peridium tough, membranous, persistent, shining, usually more or less iridescent. Columella usually conspicuous, cylindric or clavate, attaining from one-third to two-thirds the height of the sporangial cavity, rarely shorter, occasionally reaching the tip. Capillitium arising mainly from the tip of the columella, the branches thinner and often paler as they approach the periphery. Spores dark in mass.

Type species, Physarum columbinum Pers.

Lamproderma is closely related to both Diachea and Comatricha. From the former, as here restricted, it is separated by the complete lack of lime except as noted under L. verrucosum; from those Comatrichas with abundant capillitium by the usually much more persistent peridium and by the tendency of the capillitium to originate at or near the tip of the columella. Old, weathered specimens of Lamproderma, in which the peridium has disappeared, can be separated from Comatricha only by the aspect of the capillitium and by the spores, which are often distinctive.

The numerous species and subspecific taxa recognized by various authors, especially Meylan (1932), emphasize the difficulties of determining the limits of species in this genus. At present, it seems best to interpret the evidence as indicating a wide capacity for variation in most of the species and to enlarge the concepts of the species to conform with that interpretation. In that respect, as in others, we follow the careful study of Dennison (1945a).

KEY TO SPECIES

- a. Spores strongly and completely banded-reticulate,
 11-16 μ; short-stalked or sessile, rarely plasmodiocarpous.
 L. cribrarioides
- a. Spores not banded-reticulate; crested, warted or spiny to nearly smooth, the warts sometimes arranged in a usually imperfect reticulate pattern.

b

 Spores bearing vesicular crests, these often forming a broken reticulation.

L. cristatum

b. Spores not bearing vesicular crests.

C

 Peridium silvery blue, marked with conspicuous depressed, dark areas; spores dark, echinulate, 12–15 μ.

L. gulielmae

c. Peridium uniform, without depressed dark areas.

d

		usually greatly exceeding half the total height.	е
	d.	Sessile, or with relatively stout, short	
		stalks rarely exceeding half the total height.	g
e.		Columella divided below center	
	of sporangial cavity into several		
		it branches which give rise to the	L. arcyrionema
_		inate capillitium; spores minutely punctate, 7–9 μ.	L. arcyrionema
e.		umella not divided; capillitium rigid, the numerous nches arising mainly from the tip of the columella.	f
	f.	Sporangia globose, 0.5-1 mm in diameter,	
		varying to elongate-ellipsoid or cylindrical, total	
		height 2-4 mm or sometimes more; branches	L. columbinum
	f.	of capillitium dark at base; spores dark, 11–14 μ.	D. Columbinani
	1.	Sporangia globose, mostly 0.3–0.4 mm in diameter, sometimes smaller; main	
		branches of capillitium pale at base,	
		becoming abruptly darker; spores pale, 7–9 μ .	L. scintillans
g.	Capillitium attached to peridium, especially below,		
Ü		yellow funnel-shaped expansions of tips,	
		se often bearing peridial fragments after dehiscence,	
		k throughout except for expansions; spores dark,	
		ring conspicuous warts or blunt spines often	I atronomorum
~		inged in a subreticulate pattern, mostly 12–15 μ.	L. atrosporum
g.		$\label{lem:capillitium} \begin{tabular}{ll} Capillitium without funnel-shaped expansions at tips, \\ usually free from peridium, occasionally attached by slender tips. \\ \end{tabular} h$	
	h.	Sporangia fusiform on short stalks, more than	
		twice as tall as wide; peridium firm, black,	
		shining, persistent; columella reaching apex, sometimes emerging; spores minutely warted, 12–14	μ. L. fusiforme
	h.	Sporangia usually subglobose or ovate,	μ. Ε. jasijornie
	11.	rarely cylindrical but then not fusiform;	
		peridium membranous; columella not emerging.	i
i.	Spo	-	L. tuberculosporum
i.	_	ores not bearing both spines and tubercles.	j
	į.		
	,	sporangia globose to ovate-cylindrical.	L. echinulatum
	j.	Spores warted or spinulose, rarely attaining 15 μ , usu	ally
			indrical. k
k.		umella pale brown; capillitium pallid, with rosy tints;	
		sile or short-stalked; spores warted, mostly $11-12 \mu$.	L. pulchellum
k.	Col	umella dark; capillitium dark except for	
	tips which may be pale or colorless; usually		
		lked, the stalk often half the total height.	1
	1.	Spores minutely verrucose, with small blunt spines or nearly smooth, mostly $11-14 \mu$, sometimes larger.	L. sauteri
	1.	Spores rarely exceeding 13 μ .	m m
m.		orangia small, mostly 0.2–0.4 mm in diameter;	
111,	cap	oillitium dark; spores strongly warted or spiny.	n
m.		orangia usually larger (0.3-)0.5-1.4 mm in	
		meter; spores minutely warted or spinulose.	0
	n.	Stalk black; spores bearing large, sharp,	L. muscorum
	n	irregularly scattered spines, mostly 11–13 μ. Stalk pale dull orange; spores	ы. muscorum
	n.	bearing blunt spines or warts,	
		sometimes arranged in a reticulate pattern.	L. verrucosum
		J	

Stalks long, relatively slender,

d.

b. Capillitium somewhat rigid at base, tending to become lax and flexuous, the main threads pale as they leave the columella, becoming darker, then fading toward the colorless tips; sporangia of moderate size, 0.3-1 mm in diameter; spores pale, minutely warted, 8-11 \(\mu \).

L. arcyrioides

Capillitium rigid and dark at base, becoming somewhat circinate and fading to the pale tips; sporangia robust,
 0.7–1.4 mm in diameter; spores dark, verrucose, 10–12 μ.

L. carestiae

Lamproderma arcyrioides (Sommerf.) Rost., Mon. 206. 1874.

Stemonitis arcyrioides Sommerf., Mag. Naturvid. 7: 298. 1827.

Stemonitis violacea Fries, Syst. Myc. 3: 162. 1829. Not S. violacea Roth, 1788, nor S. violacea Schum., 1803.

Lamproderma violaceum (Fries) Rost., Mon. 204. 1874 (as violacea).

Lamproderma nigrescens Sacc., Michelia 2: 262. 1881. Not L. nigrescens Rost., 1874.

Lamproderma saccardianum Massee, Mon. 101. 1892.

Tilmadoche berkeleyi Massee, Mon. 332. 1892.

Sporangia globose or depressed-globose, 0.3–1 mm in diameter, often umbilicate below, metallic blue or iridescent purple, short-stipitate or sometimes sessile, gregarious or scattered, the total height 0.6–1.5 mm; stalk, when present, usually rather stout, even, dark, short, rarely exceeding three-fifths of the total height; hypothallus a thin, continuous, reddish brown membrane, or, when the sporangia are scattered, broken up into basal disks; columella black above, brown below, nearly cylindric or tapering toward the apex, reaching the center of the sporangial cavity, the tip obtuse; capillitium lax, flaccid, flexuous, the threads branching and anastomosing to form a net which is loose at the center, denser toward the periphery, the threads nearly colorless or pale brown as they leave the columella, becoming gradually darker, then paler toward the colorless tips; spores violaceous to purplish gray by transmitted light, minutely warted, 8–11 μ in diameter. Plasmodium watery white, rarely yellow.

TYPE LOCALITY: Norway.

HABITAT: Dead wood, twigs, and leaves.

DISTRIBUTION: Maine to Washington, south to Virginia and California; Jamaica, Puerto Rico; Europe; Tasmania.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 132, a-e; Macbr. & Martin, Myxom. pl. 13, f. 318, 319; Nat. Geogr. Mag. 49(4): pl. 10; Mycologia 37: 88, f. 6; 91: f. 17.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2698, 3199; Jaap, Myxom. Exs. 116, 135; Brândză, Myxom. Roum. 48(IA).

This species is better known as *L. violaceum*, since that name was used by Rostafinski and was still used in the third edition of the Lister monograph, by Macbride and Martin, and by Hagelstein. However, Miss Lister specifically recognized that the name was invalid. She included in her treatment the varieties carestiae and sauteri, both of which are here treated as distinct species, suggesting that they represent no more than responses to an alpine environment. This is of course possible, but Meylan, in various papers, stressed the existence of a distinct group of primarily alpine species, including several Lamprodermas, which seem to be constant and distinct. While we do not believe it is possible to recognize all of Meylan's names, especially those to which he assigned subspecific rank, his studies emphasize the position of *L. arcyrioides* as the dominant species in a closely

FIG. 186 Plate XX related group somewhat analogous to that of Hemitrichia clavata in its genus.

The species is not uncommon in temperate North America and may occur in extensive fruitings, with sporangia in the same cluster varying from sessile to stipitate.

Lamproderma arcyrionema Rost., Mon. 208. 1874.

FIG. 187 *Plate* XX Lamproderma subaeneum Massee, Mon. 95. 1892 (as suboeneum).

Comatricha shimekiana Macbr., Bull. Nat. Hist. Univ. Iowa 2: 380. 1893.

Paradiacheopsis arcyrionema (Rost.) Hertel, Dusenia 7: 348. 1956.

Collaria arcyrionema (Rost.) Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 70: 209. 1967.

Sporangia globose, (0.25-)0.4-0.6(-0.75) mm in diameter, stipitate, erect, silvery gray or iridescent bronze, the total height 1–2.5 mm; stalk slender, rigid, black, two-thirds to three-fourths the total height; peridium membranous, silvery, the base persisting as a collar after the upper portion has broken away; columella cylindric, slender, attaining one-third to one-half the height of the sporangium and there dividing into two or more thick branches which by further division give rise to the dense, curled branches of the capillitium, these anastomosing and often leaving few free ends, or, if many, these short and inconspicuous; spores black in mass, violaceous gray by transmitted light, minutely punctate, sometimes with darker clusters, (6-)7-9(-10) μ in diameter. Plasmodium watery white.

TYPE LOCALITY: Poland.

HABITAT: Dead leaves and wood.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 129; Macbr. & Martin, Myxom. pl. 13, f. 322, 323; Nat. Geogr. Mag. 49(4), pl. 6; Hattori, Myxom. Nasu, pl. 13, f. 4; Mycologia 37: 88, f. 9.

EXSICCATI: Ellis & Ev., N. Am. Fungi 1400, 2898; Brândză, Myxom. Roum. III. 2: 21; 57(NY); 7(IA); Hintikka, Myxogast. Fenn. 8 (as L. columbinum); Thaxter, Rel. Farl. 402.

Similar to L. scintillans as seen in the field but with a more silvery peridium and quite different capillitium, and paler, less strongly marked, and usually somewhat smaller spores.

G. Lister, in Mycet. ed. 3. 153 reported a collection from Japan with unusually lax and slender capillitium and dark spores 8–9 μ in diameter. This was named var. *japonicum* Meylan, Bull. Soc. Vaud. Sci. Nat. 58: 323. 1935.

Lamproderma atrosporum Meylan, Bull. Soc. Vaud. Sci. Nat. 46: 51. 1910.

FIG. 196 *Plate* XXI Sporangia sessile or stalked, pulvinate or globose to elliptic or obovate, 0.6–1.2 mm in diameter, the total height 1–2.5 mm; peridium dark purple-black with silvery sheen, fragile, fugacious, breaking up above into small fragments which tend to adhere to the capillitium, usually thicker and persistent at the base; stalk usually present, rather short, stout, but sometimes equalling or exceeding the sporangium in height; columella cylindric or clavate, often stout, reaching nearly to the center of the sporangial cavity; capillitium olive-brown to black, without traces of violet, the tips frequently expanded, particularly below, into funnel-shaped yellowish enlargements attached to the peridium, fragments of which may persist as conspicuous, irregular disks or plates; spores

black in mass, dark by transmitted light, coarsely echinulate, the short, blunt spines sometimes arranged in sinuous lines over a portion of the surface forming a vague and incomplete reticulation; 12-15(-17) μ in diameter. Plasmodium black.

TYPE LOCALITY: Jura Mts., Switzerland.

HABITAT: Dead wood and plant litter, especially near melting snow-banks. DISTRIBUTION: Central Europe; mountains of western United States and Canada.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 133, f-i; Macbr. & Martin, Myxom. pl. 13, f. 312, 313; Mycologia 37: 88, f. 3; 91, f. 4 (as L. robustum). EXSICCATI: Jaap, Myxom. Exs. 178.

This includes the species discussed by Dennison (1945) as L. robustum Ell. & Ev. Her treatment was accepted by Martin (1949). In both works L. atrosporum was cited as a synonym of that species. The restoration of L. atrosporum in its place is based largely on unpublished notes of D. T. Kowalski. Kowalski examined many specimens from the western mountains, including our portion of the type of L. robustum and came to the conclusion that it is an old and weathered fruiting of L. sauteri. L. robustum therefore becomes a synonym of that species. He has found that in L. sauteri, as in L. atrosporum, the attenuated tips of the capillitium may be attached to the peridium, but never become enlarged into funnel-like structures as in L. atrosporum. The peridium of L. atrosporum is darker and duller and the spores are somewhat larger and darker than are those of L. sauteri and more conspicuously warted and the warts tend to be arranged in a reticulate pattern. After the peridia have been shed, the pale slender capillitial tips of L. sauteri give the sporangia a hoary appearance, which is not the case in L. atrosporum.

The varieties anglicum and debile of G. Lister & Howard (See Mycetozoa ed. 3. 160, pl. 216. 1925), as described, suggest distinct species, but further study is needed before their status can be evaluated. Both were found at low altitudes in England.

Lamproderma carestiae (Ces. & de Not.) Meylan, Bull. Soc. Vaud. Sci. Nat. 57: 368. 1932.

Stemonitis carestiae Ces. & de Not., Erb. Crit. Ital. 888. 1879.

Lamproderma violaceum var. carestiae (Ces. & de Not.) A. Lister, Mycet. 130. 1894.

Lamproderma sauteri var. carestiae (Ces. & de Not.) Meylan, Bull. Soc. Vaud. Sci. Nat. 51: 264. 1917.

Lamproderma fuscatum Meylan, Bull. Soc. Vaud. Sci. Nat. 57: 372. 1932.

Sporangia sessile or with a short stipe, subglobose or usually taller than wide, 0.7–1.4 mm in diameter, violet-blue or bluish bronze with shining, metallic reflections; stalk, when present, short, or rarely attaining half total height of 0.6–2 mm; columella cylindric, about half the height of the sporangium; capillitium dense, rigid at base, then circinate, dark purple-brown or black, fading to colorless at the tips; spores violaceous brown, verrucose, 10–12 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Italy.

HABITAT: Turf and herbaceous stalks and twigs in mountainous regions.

DISTRIBUTION: Europe; Colorado, Utah, Oregon, California.

FIG. 188 Plate XX ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 132, h-l; Macbr. & Martin, Myxom. pl. 13, f. 316, 317; Mycologia 37: 88, f. 5; 91, f. 16.

EXSICCATI: Brândză, Myxom. Roum. 12(IA).

Meylan (1931) restricted *L. carestiae* to sessile forms with globose or flattened sporangia. The stalked forms are distributed amongst other species. In Brândza's No. 12, which is selected for illustration, most of the sporangia are stalked, but sessile sporangia, obviously arising from the same hypothallus, are intermingled with them. *L. fuscatum* Meylan is described as distinguished from *L. carestiae* by the constant presence of a short stalk and the smaller spores. It should be regarded as a synonym, since it does not seem possible to restrict *L. carestiae* to sessile fruitings and the spore size is not significantly different. From *L. sauteri*, with which *L. carestiae* is most likely to be confused, it may be distinguished by its paler colors, the usually shorter stalks, the greater tendency to develop sessile fruitings and its smaller and less prominently warted spores. These characters suggest little relationship with *L. arcyrioides* (*L. violaceum*).

There is no "L. arcyrioides Morgan" as cited in the second and third editions of the Lister monograph as a synonym of this species.

The species seems to be rare in North America and some of the reports of its occurrence are doubtful.

Lamproderma columbinum (Pers.) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27–28: 69. 1873.

Physarum columbinum Pers., Ann. Bot. Usteri 15: 5. 1795.

Stemonitis physaroides Alb. & Schw., Consp. Fung. 103. 1805.

Trichia columbina (Pers.) Poir., in Lam., Encyc. 8: 52. 1808.

Physarum iridescens Berk., Jour. Bot. & Kew Misc., 3: 20. 1851.

Lamproderma physaroides (Alb. & Schw.) Rost., Mon. 202. 1874.

Lamproderma schimperi Rost., Mon. 203. 1874.

Lamproderma iridescens (Berk.) Rost., Mon. App. 25. 1876.

Lamproderma cruchetii Meylan, Bull. Soc. Vaud. Sci. Nat. 52: 96. 1918.

Lamproderma columbinum var. subglobosum Meylan, Bull. Soc. Vaud. Sci. Nat. 55: 242. 1924.

Lamproderma brevipes (G. Lister) Meylan, Bull. Soc. Vaud. Sci. Nat. 56: 322. 1927.

Lamproderma subglobosum (Meylan) Meylan, Bull. Soc. Vaud. Sci. Nat. 56: 322. 1927.

Sporangia globose or ellipsoid, rarely cylindrical, scattered or gregarious, 0.5–1 mm in diameter, rich violet or purple with a metallic iridescence, the total height 2–4(–5) mm; peridium membranous, persistent; stalk usually long, two-thirds to three-fourths the total height, rarely shorter, black, straight, subulate; columella cylindric, with a conic or somewhat blunt apex, one-third to one-half the height of the sporangium; capillitium brownish purple, originating from all parts of the columella, rigid, sparingly forked at the center, then anastomosing to form a large-meshed open net; spores black in mass, smoky brown by transmitted light, minutely warted (9–)10–13(–14) μ in diameter. Plasmodium white.

TYPE LOCALITY: Europe.

HABITAT: Coniferous wood, mossy stumps and logs.

DISTRIBUTION: Europe; temperate North America; Tasmania.

ILLUSTRATIONS: Alb. & Schw., Consp. Fung. pl. 2, f. 8. Lister, Mycet. ed.

FIG. 189 Plate XX 3. pl. 131, a, e, f, g, l, m; Macbr. & Martin, Myxom. pl. 13, f. 326, 327; Mycologia 37: 88, f. 10.

EXSICCATI: Rab., Fungi Eur. 2213; Jaap, Myxom. Exs. 14; Brândză, Myxom. Roum. I. 1: 16; III, 2: 22, 59 (NY); 10, 21 (IA); Thaxter, Rel. Farl. 403.

The varieties gracile G. Lister, Mycet. ed. 3. 155. 1925, iridescens (Berk.) G. Lister, Trans. Brit. Mycol. Soc. 9: 36. 1923, and brevipes G. Lister, Mycet. ed. 3. 155, 1925, are separated from the typical form only by variations which appear to be due to environmental fluctuations at the time of fruiting and to be unworthy of recognition. However, Meylan's treatment of the genus, and particularly his discussion in his 1927 paper, cited above, should be carefully studied in this connection. Our material from the Pacific coast includes a number of robust specimens, sometimes 5 mm or more in height, but they seem to merge into the somewhat smaller eastern and European collections by a complete series.

Fulgia encaustica Chev., Jour. de Physique 92: 58. 1822, cited in the literature as a synonym of this species, is unidentifiable. See Martin (1966).

Lamproderma cribrarioides (Fries) R. E. Fries, Sv. Bot. Tidskr. 4: 259. 1911. Stemonitis cribrarioides Fries, Syst. Myc. 3: 163. 1829.

Lamproderma lycopodii Raunk., Sv. Bot. Tidskr. 17: 90. 1888.

Sporangia globose, 0.8–1 mm in diameter, scattered or clustered, sessile or stalked, rarely plasmodiocarpous, purple-brown, iridescent, the total height 1–1.6 mm; peridium membranous, hyaline above, purplish brown below; stalk, when present, black, weak, often flattened or membranous, and appressed to the substratum, 0.1–0.6 mm high; columella cylindric, penetrating the sporangium to about one-half the height of the cavity, absent in plasmodiocarpous forms; capillitium a network of pale, purplish brown, flexuous threads which are stout at the base, slender and colorless at the tips; spores black in mass, dark purplish brown by transmitted light, regularly and distinctly reticulate by narrow bands 0.5–1.5 μ high forming a net of 8–24 meshes to the hemisphere, 11–16 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Germany.

HABITAT: Coniferous wood and litter of various sorts.

DISTRIBUTION: Europe; Colorado, California; Philippines.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 133, a-e; Macbr. & Martin, Myxom. pl. 13, f. 309, 310; Mycologia 37: 88, f. 1; 91, f. 12.

The large, strongly reticulate spores and the pale brownish capillitium are the most striking characters of this species. Sessile and stipitate sporangia occur together in the same fruiting. Some are truly sessile, but others which appear so at first inspection are really stalked, with weak stalks prone on the substratum, while others are clearly lifted on the stalks. The species is apparently rare in Europe and is known from North America from only two localities, in central Colorado and northern California.

Lister's pl. 133 a illustrates a plasmodiocarpous fruiting, suggesting a Diacheopsis.

Lamproderma cristatum Meylan, Bull. Soc. Vaud. Sci. Nat. 53: 457. 1921.

Sporangia spherical or ovate, sessile or very short-stalked, crowded or scattered, 1–1.5 mm in diameter, total height 1.5–2 mm; peridium dark gray to iridescent, thin, membranous, disappearing rather early; columella subcylindrical, sometimes tapering upward; capillitium rather pale, gray or pur-

FIG. 190 Plate XX

FIG. 191 Plate XXI plish, radiating as flexuous, anastomosing threads from the columella, colorless at tips; spores globose, dark purplish brown in mass, purplish gray by transmitted light, marked with vesicular, warted crests, 12–15 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Ste. Croix, Switzerland.

HABITAT: On leaves and twigs near melting snow.

DISTRIBUTION: Jura Mountains, Switzerland.

ILLUSTRATIONS: Bull. Soc. Vaud. Sci. Nat. **53**: 457, f. B; Lister, Mycet. ed. 3. pl. 216, f. h; Mycologia **37**: 88, f. 2; 91, f. 13.

The curious crested spores are distinctive and unlike those of any other species of *Lamproderma*. The vesicles on the spores are arranged in lines and groups, but the pattern is at most subreticulate.

Lamproderma echinulatum (Berk.) Rost., Mon. App. 25. 1876.

FIG. 192 Plate XXI Stemonitis echinulata Berk., in Hooker, Fl. Tasm. 2: 268. 1860.

Lamproderma listeri Massee, Mon. 97. 1892.

Lamproderma echinosporum Meylan, Bull. Soc. Vaud. Sci. Nat. 55: 241. 1924.

Sporangia globose to cylindrical-ovate, loosely clustered, 0.5–1 mm in diameter; total height 2–4 mm; peridium shining, steel blue with gray or green iridescence, membranous, persistent; stalk cylindrical or subulate, black, 1–3 mm high; columella cylindrical, obtuse, rising to one-half the sporangial cavity; capillitium arising mainly from apex of columella, stout, sparingly forked and anastomosing, purplish brown, slender and colorless at tips; spores dark gray or brownish purple, strongly aculeate, 15–20 μ in diameter. Plasmodium opaque white.

TYPE LOCALITY: Tasmania.

HABITAT: Dead wood.

DISTRIBUTION: Tasmania; New Zealand; Sweden, England, Ireland, Switzerland; India; Japan.

ILLUSTRATIONS: Jour. Bot. 29: pl. 310, f. 2; Lister, Mycet. ed. 3, pl. 134, f. a-i, k; Hattori, Myxom. Nasu, pl. 13, f. 6.

Our only specimens, from New Zealand, are cylindrical-ovate and over-mature, but agree in all respects but shape with the earlier descriptions. The large, strongly aculeate spores are unlike those of any other species except those of *L. gulielmae*, which is strikingly different in other respects, and *L. echinosporum*, which is entered as a synonym on the basis of the original description and Meylan's (1932) later key and comments.

Lamproderma fusiforme Kowalski, Mycologia 58: 808. 1966.

Comatricha fusiforme (Kowalski) Kowalski, Mycologia 60: 763. 1968.

Sporangiate, stipitate, fusiform, 0.7-1 mm in diameter, 2-2.5 mm high, black, with silvery reflections; stalk black, short, 0.1-0.4 mm in length; total height up to 2.8 mm; peridium membranous, silvery gray; columella attaining tip of sporangium and there often enlarging as a cup-like tip attached to the apex or sometimes emerging as a spike; capillitium dense, dark, circinate, forming an intricate, persistent net, with numerous dark free ends, especially toward

the margin, and bearing clusters of dark granules, often appearing like warts or spines, especially toward the tips; spores globose, dark grayish brown, minutely warted, 12 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Mt. Shasta, California.

HABITAT: Dead wood.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATION: Mycologia 58: 809, f. 1.

The only known Lamproderma with a definitely fusiform sporangium although the cylindrical-ovate forms of L. echinosporum approach it in that respect. It is also close to some forms of Comatricha suksdorfii with persistent peridium, but the dark granular bodies on the capillitium, of about the size of dictydine granules, but sometimes elongated, have not been observed in that species.

Lamproderma gulielmae Meylan, Bull. Soc. Vaud. Sci. Nat. 52: 449. 1919.

Sporangia stipitate, spherical or obovoid, 0.3–0.5 mm in diameter, the total height 1–2 mm, silvery blue with black depressed spots, forming a netted peridium; stalk slender, black, subulate, 1–1.2 mm tall, entering the sporangium as a columella which reaches half-way to the summit and there gives rise to the hyaline or pallid, branching capillitium; spores dark purple, strongly echinulate, 12–15 μ in diameter. Plasmodium translucent yellow.

FIG. 193 Plate XXI

TYPE LOCALITY: Jura Mts., Switzerland.

HABITAT: Dead bark, and herbaceous stalks in mountainous areas.

DISTRIBUTION: Europe; Colorado; California.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 215, a-d; Macbr. & Martin, Myxom.

pl. 13, f. 314, 315; Mycologia 37: 88, f. 4.

EXSICCATI: Brândză, Myxom. Roum. 58(NY); 8(IA).

The sunken spots give the outline of the sporangium an undulate appearance. The spots remain on the persistent peridium after the spores have been discharged. These, together with the pale capillitium and the large echinulate spores, make this a distinctive species.

Lamproderma muscorum (Lév.) Hagelst., Mycologia 27: 88. 1935.

Enerthenema muscorum Lév., in Triana & Planch., Ann. Sci. Nat. IV. 20:

289. 1863.

Sporangia scattered, globose, stalked, erect, blue or iridescent bronze, 0.3–0.5 mm in diameter, total height 0.6–1 mm; peridium thin, membranous, more persistent at the base; stalk thick, black, shining, from one-half to two-thirds the total height, rising from a circular, purple-brown hypothallus; columella thick, tapering slightly to the obtuse end, attaining the center of the sporangial cavity; capillitium dense, the threads rigid, radiating from the tip of the columella, forking dichotomously but with few anastomoses, purple-brown throughout; spores black in mass, violet-brown by transmitted light, with large, blunt, irregularly scattered spines, (6.5–)8–10(-14) μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Colombia. HABITAT: Dead leaves.

DISTRIBUTION: Colombia; ?New York, ?Pennsylvania; Costa Rica.

FIG. 194 Plate XXI ILLUSTRATIONS: Mycologia 27: 87. Hagelst. Mycet. N. Am. pl. 4; Mycologia 37: 88, f. 7. All questionable.

The small size, the rigid capillitium, the relatively short stem and the rather sparsely scattered, conspicuous blunt spines of the spores are the marks of this species. Léveillé did not describe either the peridium or the spores and his reference of the species to *Enerthenema* suggests that his specimen was old. A. Lister, Mycet. 129. 1895, reported that the type, now in the British Museum, had sparsely, but strongly warted spores, 8-9 μ in diameter. He said the specimen corresponded, except in that respect, with English specimens at that time referred to L. iridium Massee. However, in the later editions of the Lister monograph, Massee's species was relegated to synonymy with L. scintillans. The scanty portion of the specimen from the Adirondacks on which Hagelstein based his transfer, which is in the IA collection, is very old and weathered, and the spores are sparsely but not particularly strongly warted and 12-14 μ in diameter. Hagelstein's plate 4 in the Mycetoza N. A. does not suggest the species. A very fine collection from Sáenz, UCR 275, from Costa Rica, now in the Texas herbarium as UTMC 1433, appears to be the closest approach to what Léveillé described that we have seen. It is quite possible that Hagelstein's material was not the same, but there can be no doubt that Léveillé's species was a Lamproderma with spores corresponding to those of the Costa Rica specimen and Hagelstein's combination is valid even though the material on which it was based is dubious. Our description and illustration was based on Hagelstein's material, except for the altered spore dimensions, and must, therefore, be accepted only with reservation.

The occurrence on leaves, stressed by Hagelstein, cannot be regarded as of great importance, since other Lamprodermas occasionally fruit on leaves and *L. arcyrionema* and *L. scintillans* do so rather frequently.

Lamproderma pulchellum Meylan, Bull. Soc. Vaud. Sci. Nat. 57: 369. 1932.

fig. 195 *Plate* XXI Sporangia densely clustered on an inconspicuous hypothallus, subglobose, sessile on a constricted base, or short-stipitate, deep violaceous blue with brilliant metallic reflections, (0.4-)0.6-0.8(-1) mm in diameter; stalk, when present, cylindrical, black; columella slender, short, pale brown; capillitium pale brownish yellow, flattened, expanded at the nodes, forming a dense net; spores black in mass, smoky brown by transmitted light, minutely warted (10-)11-12(-13) μ . Plasmodium unknown.

TYPE LOCALITY: Jura Mountains, Switzerland.

HABITAT: Dead herbaceous leaves and stems.

DISTRIBUTION: Known only from the type locality.

This beautiful species is distinguished by its comparatively small size and pale columella and capillitium. The above description is based on an excellent example from Meylan, and differs somewhat from the original description, which does not mention the occasional stalked sporangia which occur intermixed with the sessile majority. A mounted specimen which appeared to be sessile in situ actually had a short stalk immersed in the slightly umbilicate base. The capillitium is said to be pale rosaceous but we fail to note any rosy tints. There is some suggestion that the capillitium is attached to the peridium at the base, as in *L. atrosporum*.

Lamproderma sauteri Rost., Mon. 205. 1874.

FIG. 197 Plate XXI Lamproderma robustum Ell. & Ev., Bull. Washburn Lab. Nat. Hist. 1: 5. 1884.

Lamproderma violaceum var. sauteri (Rost.) A. Lister, Mycet. 129. 1894.
Lamproderma sauteri var. robustum (Ell. & Ev.) Graff, Mycologia 20: 106.
1928.

Sporangia stipitate or sessile, globose or slightly depressed, more or less flattened below, rarely umbilicate, 1–2 mm in diameter, the total height 1–4 mm; peridium membranous, persistent, dark blue with a metallic luster, not brilliant; stalk usually short, rarely exceeding the height of the sporangium, black, subulate or cylindrical, from a firm, well-developed hypothallus; columella reaching about the center of the sporangium, truncate or slightly enlarged at the tip; capillitium coarse, rigid, purplish, with paler tips, appearing hoary after the spores are shed; spores black in mass, purplish brown by transmitted light, verrucose or with blunt spines, (11-)12-14(-16) μ in diameter. Plasmodium probably white or colorless.

TYPE LOCALITY: Salzburg, Austria.

HABITAT: Wood, leaves, and debris, mainly of coniferous trees; sometimes encrusting living plants.

DISTRIBUTION: Europe; Ontario, Michigan, Montana, Colorado, Arizona, British Columbia, Washington, Oregon, California.

ILLUSTRATIONS: Lister, Mycet, ed. 3. pl. 132, f. g, m; Macbr. & Martin, Myxom. pl. 13, f. 320, 321; Mycologia 37: 88, f. 8; 91, f. 19.

EXSICCATI: Brândză, Myxom. Roum. 11(IA).

As here defined, this is the commonest Lamproderma in the western mountains of Canada and the United States. The reports of its occurrence in Michigan and Ontario are based on Hagelstein (1944); we have not seen his specimens. Those from Ontario in the Iowa collection which were tentatively referred to L. sauteri, are better referred to L. columbinum.

Meylan (1931), in his report on the Lamprodermas of the Swiss snowfields, restricts the species to stipitate forms, excepting what he calls abnormal fruitings. He also recognizes two named varieties and two named forms. In a single fruiting from Meylan, sessile forms occur amongst the predominantly stalked forms, obviously from the same plasmodium, and some of the stalked forms have slender, cylindrical stalks rather than the stouter, subulate stalks of the majority. The spores of the European collections seem to be somewhat more coarsely marked than the collections from the western mountains, but in all of these characters there appears to be complete intergradation. Allowing for the vissisitudes of the alpine environment, it seems to be clear that *L. sauteri* is a highly variable species but that the variations are the result of environmental conditions at the time of fruiting and that the numerous specific, varietal, and form names are the cause of more confusion than help in understanding these species.

Lamproderma ovoideum Meylan, Bull. Soc. Vaud. Sci. Nat. 57: 373. 1932, its variety cucumer Meylan (I.c., p. 371) and variety piriforme Meylan (I.c., p. 370) and its form globosum Meylan (I.c., p. 367) may all belong here. The var. piriforme had earlier been attached to L. sauteri by Meylan but in the paper cited he says there is nothing in common between sauteri and the variety; the limited material does not seem to confirm Meylan's view. On the other hand, the large spiny spores and the dark capillitium do not agree. We have a single specimen from Meylan labelled "Lamproderma piriforme Meylan" (comb. apparently not published), which is presumably L. ovoideum var. piriforme Meylan. The spores are dark, strongly but somewhat irregularly spiny, the bodies $14-15~\mu$, with the spines $15-16~\mu$ in diameter and there is some suggestion that the capillitium is attached to the peridium as in L. atrosporum. This may be what was later called L. echinosporum Meylan. The capillitium is dark to the tips, but is strongly netted and does not suggest that species. L. ovoideum may be a good species; the subspecific taxa are probably not well founded.

L. sauteri var. fallax Meylan, Bull. Soc. Vaud. Sci. Nat. 58: 320. 1935, is said to be distinguished by its pale rose capillitium.

Lamproderma splendens Meylan, Bull. Soc. Vaud. Sci. Nat. 57: 44. 1929, is

certainly very close to *L. sauteri*, and the distinctions as he gives them makes it doubtful whether it should be recognized.

"Lamproderma arcyrioides Morgan," cited in the second and third editions of the Lister monograph as a synonym, has no validity.

FIG. 198 Plate XXI Lamproderma scintillans (Berk. & Br.) Morgan, Jour. Cinc. Soc. Nat. Hist. 16: 131. 1894.

Stemonitis scintillans Berk. & Br., Jour. Linn. Soc. 15: 84. 1876.

Lamproderma arcyrioides var. iridea Cooke, Myxom. Gr. Brit. 50. 1877.

Lamproderma irideum (Cooke) Massee, Mon. 95. 1892.

Sporangia stalked, erect, globose, (0.2-)0.3-0.4(-0.5) mm in diameter, metallic silvery, blue, or bronze, iridescent, total height 1–2 mm; stalk usually long, slender, nearly cylindrical, black, nodding or erect, rising from a small circular hypothallus, sometimes short; columella cylindric, truncate, not exceeding the center; capillitium dense, of rigid, straight, sparingly branched and anastomosing threads, pallid or colorless as they leave the columella, elsewhere brown; spores violaceous brown, regularly and distinctly warted, 7–9(-10) μ in diameter. Plasmodium watery white.

TYPE LOCALITY: Ceylon.

HABITAT: Dead leaves, moss, and vegetable litter; less commonly on wood or dung.

DISTRIBUTION: Southern and eastern Asia; southern Canada, south to Panama; West Indies; South America; Great Britain, Germany; Hawaii.

ILLUSTRATIONS: Lister, Mycet, ed. 3. pl. 130; Macbr. & Martin, Myxom. pl. 13, f. 324, 325; Mycologia 37: 88, f. 11; 91, f. 22.

EXSICCATI: Ellis & Ev., N. Am. Fungi 3600; Jaap, Myxom. Exs. 73, 115.

The small, iridescent, often silvery sporangia occur rather commonly on dead leaves. It is even smaller than $L.\ arcyrionema$, from which it differs especially in its rather rigid capillitium, with few branches and anastomoses. The numerous main branches are clustered at the tip of the columella and are usually notably pale at the bases.

Lamproderma tuberculosporum Farr, Mycopathologia 31: 311. 1967.

Sporangia globose, stipitate to nearly sessile, gregarious or clustered and then sometimes adnate, (0.3-)0.5-0.7 mm in diameter, total height up to 1 mm or slightly more; peridium membranous, iridescent with blue, purplish and greenish reflections, persistent below and more or less so above, sprinkled with pallid granules 0.5-1 μ in diameter; stalk black, opaque, rather thick, subulate, varying from very short to nearly half the diameter of the sporangium and extending into the subcylindrical, blunt columella which attains the middle of the sporangial cavity; capillitium arising from tip and sides of the columella, of dark brown, flexuous threads, branching and anastomosing to form a moderately dense net-work with expanded junctions, occasional rounded thickenings, and numerous short, brown free ends, culminating at the periphery in delicate, faintly colored or colorless, hyaline tips; hypothallus discoid, often connected by veins with others, or forming a continuous layer; spores dark brown in mass, smoky by transmitted light, globose, covered rather irregularly by broad-based, scattered spines up to 2 μ long and by scattered, rough tubercles 2-3 μ in diameter, the body of the spores $11-14 \mu$ in diameter. Plasmodium unknown.

TYPE LOCALITY: Toquiza, Dept. Cundinamarca, Colombia.

HABITAT: On living leaves of *Hymenophyllum*. DISTRIBUTION: Known only from the type collection. ILLUSTRATIONS: Mycopathologia 31: 308, f. 4, 7.

Chiefly characterized by the spore markings, which are unlike those of any other species.

Lamproderma verrucosum Martin, Thind and Sohi, Mycologia 49: 130. 1957.

Sporangia globose, varying to ovate or depressed, stipitate to substipitate, 0.2–0.3(–0.4) mm in diameter, dark blue, iridescent; stipe pale, dull orange, subcylindrical, tapering upward, slightly furrowed, short, sometimes flattened to substratum or obscured so that sporangia appear sessile; hypothallus brown; peridium thin, hyaline, nearly colorless, persistent, wrinkled, opening irregularly from above; columella conical, short; capillitium dark, with abundant anastomoses forming a close net, with numerous spiny tips toward the periphery; spores black in mass, dark smoky brown by transmitted light, prominently and irregularly spiny-verrucose, the warts sometimes arranged in short lines in a subreticulate pattern, globose, 9–11 μ in diameter, including the warts, or oval and correspondingly longer and narrower. Plasmodium unknown.

TYPE LOCALITY: Mussoorie, India.

HABITAT: Dead leaves.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATION: Mycologia 49: 130, f. 2.

Fig. 1 A, accompanying the original description, shows the sporangia as somewhat taller than broad. In the portion of the type in the Iowa collection, the sporangia are all somewhat depressed and many appear sessile. The stalk and columella are filled with minute granules, suggesting lime, but these do not dissolve in acid. In addition, coarse crystal-like bodies have been observed at the base of the stalk. If lime is indeed present, this species must be transferred to Diachea, which in other respects it strongly suggests. Additional collections are needed. The spores are unique. It is difficult to decide whether the markings should be called warts or spines, but even the longer ones, which may attain 1 μ in length, tend to be blunt and are perhaps better described as elongate warts. In a minority of the spores these structures are arranged in lines, but in most they are merely irregularly distributed.

DOUBTFUL SPECIES

Lamproderma inconspicuum Schroet., in Hennings, Hedwigia 35: 208. 1896.

Cited by G. Lister, Mycet. ed. 3. 153, as "L. inconspicuum Racib.", as a possible synonym of L. arcyrionema. It is described as very small, with a rudimentary columella and pale spores, 6-8 μ . Possibly distinct.

Lamproderma leucosporum Rost., Mon. App. 26, 1876.

Cited by G. Lister, Mycet. ed. 3. 156, as a possible synonym of L. violaceum (L. arcyrionema). Berlese, in Sacc., Syll. 7: 393, cites L. nigrescens Rost. non Sacc. as a synonym of L. leucosporum, but regards L. nigrescens Sacc. non Rost. as distinct, and includes neither under L. arcyrionema or L. violaceum.

Lamproderma minutum Rost., Mon. App. 26. 1876.

Cited by G. Lister, Mycet. ed. 3. 156, as possible synonym of L. violaceum.

Lamproderma staszcii Racib., Hedwigia 28: 116. 1889.

Cited by G. Lister, Mycet. ed. 3. 155, as a possible synonym of L. columbinum var. brevipes. Raciborski described the capillitial threads as ribbonFIG. 199 Plate XXI like, very broad, up to 30 μ , and quite unlike those of any other species of the genus.

Lamproderma tatricum Racib., Hedwigia 28: 117. 1889.

Cited by G. Lister, Mycet. ed. 3. 156, as possible synonym of L. violaceum.

Comatricha

Preuss, Linnaea 24: 140. 1851.

Rostafinskia Racib., Rozp. Akad. Umiej. 12: 77. 1884. Not Rostafinskia Speg., 1880.

Raciborskia A. Berl., in Sacc. Syll. Fung. 7: 400. 1888.

Paradiacheopsis Hertel, Dusenia 5: 191. 1954. p. p.

Comatrichoides Hertel, Dusenia 7: 347. 1956. Invalid.

Paradiachea Hertel, Dusenia 7: 349. 1956.

Collaria Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 70: 208. 1967.

Sporangia cylindric to globose, scattered, gregarious or densely crowded; columella typically present, usually reaching nearly to the apex of the sporangium, rarely lacking, giving rise to numerous branches which subdivide and often anastomose to form a capillitial net, the ultimate branchlets usually free; peridium free, usually evanescent, sometimes persistent; spores black, purple, or ferruginous in mass, violaceous brown to pallid by transmitted light.

Type species, Stemonitis obtusata Fries.

Comatricha is closely related to Stemonitis, from which it is separated by the lack of the surface net characteristic of the latter genus. Even in such species as C. typhoides and C. laxa, where the capillitium is extensively branched and anastomosed near the surface, the lack of a surface net is apparent, whereas it is always present in Stemonitis fruitings, at least in the lower portion of the sporangium and to a greater extent than the descriptions imply in those species in which it is said to be lacking above. In S. hyperopta, for example, there are often traces of a delicate net in the upper part of the sporangium although it falls away more quickly than in other species.

Ross (1957) showed that in three species of Stemonitis, the capillitium developed both from the columella and from loci within the sporogenous mass and that the net developed just under the surface from loci within the peripheral protoplasm, while in Comatricha typhoides the entire capillitial system arose from the columella. Goodwin (1961) studied three additional species of Comatricha and found that they developed as described by Ross for C. typhoides. This suggests that the presence or absence of a net may be of fundamental significance.

Hertel (1956) suggested extensive reclassification of the genus, proposing several new genera. His work has been reviewed and amplified by Nannenga-Bremekamp (1967). Alexopoulos (1967) pointed out the importance of the characters of the stalks, those of Stemonitis being typically hollow, tubular, and homogeneous, while those of Comatricha are filled with an interlaced mass of thread-like strands. Partly on that basis, he transferred three of the minute species of Comatricha to Macbrideola. Nannenga-Bremekamp recognized Paradiachea Hertel essentially as it was originally proposed, to include those species with a persistent peridium. If the genus is accepted, C. aggregata Farr might well be included. She also accepted Paradiacheopsis Hertel, with substantial modification, transferring several additional species to it, as noted in the synonymy, and divided Comatricha, as restricted, into four subgenera: Comatricha, Laxaria Nann.-Brem., Sinuaria Nann.-Brem., and Stemonitopsis Nann.-Brem. Whether these serve any useful purpose is still to be demonstrated.

KEY	TO SPECIES	h	
a.	Peridium membranous, iridescent, persistent, especially below.	b	
a.	Peridium typically evanescent, not rarely persistent in <i>C. typhoides</i> , rarely if ever in other species.	e	
	b. Sporangia 0.2–0.3 mm in diameter, densely aggregated, sometimes forming a pseudoaethalium; peridium dark, iridescent brown; stalks slender, sometimes attaining half total height; capillitium scanty, irregular.	C. aggregata	
	b. Sporangia 0.3–0.5 mm in diameter, tufted but not united; peridium bluish, silvery or bronze; stalk lacking or very short and stout; capillitium profuse.	c	
c.	Spores spiny, 10–13 μ ; peridium silvery or bronze, with bluish tints.	C. caespitosa	
c.	Spores reticulate; peridium rarely with bluish tints. d. Spores incompletely verrucose-reticulate,	d	
	12-14 μ ; peridium silvery or bronze.	C. cylindrica	
	 d. Spores banded-reticulate, 10–11 μ; peridium violaceous brown. 	C. rispaudii	
e.	Capillitium lax, open, with few or no anastomoses, forming at most a very open net with many prominent free ends.		
e.	Capillitium intricate, with many anastomosing branches, forming a net, usually dense, with short or rarely no free ends	. k	
	f. Sporangia long-cylindrical, fruiting in large, dark, densely aggregated clusters.	g	
	f. Sporangia short-cylindrical to ovate or globose, scattered or clustered but not densely aggregated.	h	
g.	Sporangia deep fuscous to black, very long and drooping, 10–50 mm; capillitium with very few anastomoses; spores conspicuously verrucose-reticulate.	C. longa	
g.	Sporangia dark brown to black, usually semi-erect, 2–8 mm in length; capillitium open, the few anastomoses forming a very open net toward the columella, with long, branching but rarely anastomosing ends; spores verrucose.	C. irregularis	
	h. Sporangia mostly short-cylindrical, sometimes varying to ovate or subglobose; columella attaining tip or nearly so, with numerous lateral branche	s. i	
	h. Sporangia globose or depressed, columella rarely exceeding center of sporangial cavity, dividing at tip or sometimes at or below base into two or more main bra		
i.	Capillitium open, rigid, branching toward ends and terminating in spinose tips which project beyond surface of spore-mass; spores prominently and coarsely reticulate, $10-13~\mu$.	C. mirabilis	
í.	Capillitium open, lax, delicate, the tips slender or somewhat enlarged but not projecting from spore-mass; spores spinulose, 6.5–7 μ .	C. longipila	
	j. Tips of capillitial branches notably enlarged; spores closely and minutely spinulose, mostly $11-13 \mu$.	C. fimbriata	
	 j. Tips of capillitial branches not enlarged; spores prominently spiny, 12–13(–20) μ. 	C. acanthodes	
k.	Sporangia predominantly elongate, cylindrical, subcylindrical or fusiform to elongate-ovate.	1	

k.	Sporangia predominantly globose or subglobose, varying to broadly ovate.		
	1. Spores olivaceous brown to purplish brown or black in	n mass. m	
	1. Spores pale lilaceous brown to ferruginous or pinkish		
m.	Robust, black; spores dark,	111 111435.	
111.	coarsely warted, mostly 10–13 μ .	C. suksdorfii	
	•	o. sansaorja	
m.	Slender, dark brown to purplish brown; spores usually smaller and less prominently marked.		
		n C distussment	
		C. dictyospora	
	n. Spores not reticulate.	0	
0.	Spores minutely warted, with 2–4 prominent		
	clusters of larger warts to the hemisphere;		
	stalks usually long, black, with a silvery sheath; peridium tending to be persistent.	C. typhoides	
_		O. typnomes	
0.	Spores uniformly warted; stalks without silvery sheath; peridium not persistent.	"	
		р	
	 Sporangia deep brown or blackish, cylindric to ovate-cylindric or ovate; 		
	stalks long, usually much more than		
	half total height. Cylindrical forms of	C. nigra	
	p. Sporangia dark brown or deep purplish brown,		
	always cylindric; stalks usually less than half total h	neight. q	
q.	Sporangia slender, acuminate;	1	
4.	stalks one-third to half total height.	C. aequalis	
q.	Sporangia plump, obtuse, stalks	,	
4.	one-fifth to one-fourth total height.	C. subcaespitosa	
	r. Sporangia fusiform, pinkish brown;	,	
	stalks usually much more than half total		
	height; capillitium uniform,		
	with no conspicuously large branches.	C. tenerrima	
	r. Sporangia cylindrical to cylindrical-ovate; stalk		
	not exceeding half total height; capillitium with		
	conspicuous large branches or forming a net with fev	w free ends. s	
s.	Sporangia pale brown, cylindrical,		
	acuminate; capillitium dense, with large basal		
	branches, many anastomoses and few free ends.	C. pulchella	
s.	Sporangia reddish brown, ovate-cylindrical; capillitium rather open, with few		
	anastomoses and many free ends. Elongate forms of	C. laxa	
	t. Sporangia dark brown to deep fuscous or blackish.	u	
	t. Sporangia bright-colored.	x	
u.	Sporangia deep fuscous or blackish; stalks long,		
	often four-fifths or more of total height, without		
	hyaline sheath; capillitium delicate, intricate,	. .	
	with many free ends; spores 9-10 μ . Usual forms of	C. nigra	
u.	Sporangia dark reddish brown, not fuscous; stalks		
	rarely attaining two-thirds of total height.	V	
	v. Sporangia broadly ovate; columella reaching		
	almost to tip, giving rise to uniform	C. laxa	
	branches throughout its length. Ovate forms of	C. iaxa	
	v. Sporangia globose or nearly so; columella	w	
•	tending to divide into large branches below tip.	w	
w.	Total height 0.6–1.5 mm; capillitium dark, rigid, with a nearly complete surface net; spores 11–13 μ .	C. rigidireta	
w.	Total height 0.3–0.6 mm; capillitium more	2. 7.8	

open, without conspicuous surface net, bearing nodular enlargements; spores 9.5–10.5 μ .

C. nodulifera

x. Columella reaching about two-thirds of sporangial cavity, giving off many large branches throughout; peridium persisting at base of sporangium as a cup or collar with capillitium attached.

C. rubens

x. Columella not exceeding center of sporangium, often shorter, and dividing into a few stout main branches, or sometimes stem dividing below base of sporangium.

у

y. Columella usually present, dividing from near base to middle of sporangium, rarely higher, into a few stout branches from which bulk of capillitium arises.

C. lurida

y. Columella very short or lacking,

dividing at or near base, or stem dividing below base of sporangium into several stout branches.

C. elegans

Comatricha acanthodes Alexop., Mycologia 50: 55. 1958.

Paradiacheopsis acanthodes (Alexop.) Nann.-Brem., K. Ned. Acad. Wet. Proc. C. 70: 209, 1965.

FIG. 157 Plate XVII

Sporangia stalked, solitary, dark brown, globose or hemispherical, flattened below, 0.2 mm in diameter, 0.4–0.5 mm in total height; peridium completely evanescent; stalk subulate, with a broad, fibrous yellowish base, dark and slender above, arising from a discoid, reddish brown, very thin hypothallus, tapering upward and continuing to the middle of the sporangium as a columella; capillitium very lax, consisting of two or sometimes three slender, black branches arising from the tip of the columella and forking three or four times without anastomosing; spores brown in mass, gray by transmitted light, globose, prominently spiny, the spines up to 1 μ long, 12–13(–20) μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Thasos, Greece.
HABITAT: On bark in moist chambers.

distribution: Greece; Virginia.

ILLUSTRATIONS: Mycologia 50: 53, f. 4, 5.

This species differs from the other minute Comatrichas in the larger, spiny spores and the characteristic capillitium. The spore range of $12-20~\mu$ given in the original description probably indicates incomplete maturity. A collection from Mt. Lake, Virginia, developed in moist chamber by Aaron Blair, has uniform spores, $12-13~\mu$, with shorter and less conspicuous spines but does not seem beyond the range of variation allowable in a species.

Comatricha aequalis Peck, Ann. Rep. N.Y. State Mus. 31: 42. 1879.

Stemonitis aequalis (Peck) Massee, Mon. 80. 1892.

Comatricha nigra var. aequalis (Peck) Sturgis, Colo. Coll. Publ. Sci. 12: 34. 1907.

FIG. 158 Plate XVII

Sporangia gregarious, stipitate, usually nodding, dark brown, cylindric, 0.4–0.6 mm in diameter; total height 2–6 mm; stalk black, polished, even, one-third to one-half the total height; hypothallus well developed, brown, continuous; columella black, attaining almost the summit of the sporangium;

capillitium dense, intricate, anastomosing, dark, with numerous short, pale, free ends; spores dark purplish brown in mass, dark violaceous brown by transmitted light, warted. (7–)8–9 μ in diameter. Plasmodium milk-white.

TYPE LOCALITY: Catskill Mts., New York.

HABITAT: Dead wood.

DISTRIBUTION: New Hampshire to Washington, south to North Carolina

and New Mexico; Costa Rica; Jamaica; Europe. ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 123, l-n.

This species has less in common with C. nigra than with C. typhoides. The cylindrical sporangia are not the deep black color of the former, from which they are further distinguished by the relatively shorter stalks and the more densely aggregated clusters. The spores are more strongly and evenly warted than those of C. typhoides and do not show the clusters of warts characteristic of that species.

Comatricha aggregata Farr, Bull. Inst. Jamaica, Sci. Ser. 7: 41. 1957.

FIG. 159 Plate XVII Sporangia stipitate with persistent peridium, broadly ovate to short-cylindrical, dark iridescent brown, 0.2–0.3 mm wide, up to 1 mm in total height, densely massed in pulvinate groups, the sporangial walls sometimes united, forming a pseudoaethalium; dehiscence apical; stalk slender, black, usually less than half the total height, flattened and light brown at base, extending into the sporangial cavity as a columella; peridium membranous, dark brown with a bronze luster, light brown and minutely granular by transmitted light; columella irregularly swollen, with light brown, membranous expansions at the tip, not reaching the apex; capillitium scanty, of a few simple or forked, purplish, irregularly thickened and wavy threads, arising from entire length of columella, but especially at the tip; hypothallus thin, horny, light brown; spores chocolate brown in mass, grayish brown by transmitted light, globose, very minutely roughened, 10– $12~\mu$ in diameter. Plasmodium unknown.

TYPE LOCALITY: St. Andrew, Jamaica. HABITAT: Decaying bamboo log.

DISTRIBUTION: Known only from the type collection. ILLUSTRATION: Bull. Inst. Jamaica, Sci. Ser. 7, f. 2; 3, c,d.

This curious species shows strong affinities with *Lamproderma* but is provisionally assigned to *Comatricha*, since the persistent peridium is shared by other species of *Comatricha*. It may be an aberrant form but this is not suggested by its uniform development and spores.

Comatricha caespitosa Sturgis, Bot. Gaz. 18: 186. 1893.

FIG. 160 Plate XVII Diachaea caespitosa (Sturgis) A. & G. Lister, Jour. Bot. 45: 186. 1907. Paradiachea caespitosa (Sturgis) Hertel, Dusenia 7: 349. 1956.

Sporangia caespitose or crowded, sessile or with very short stalks, clavate-cylindric, dark, 1–1.5 mm tall, 0.5 mm in diameter; peridium silvery, iridescent with blue or bronze reflections, tending to persist, especially below; columella tubular, attaining two-thirds to three-fourths the height of the sporangium; hypothallus delicate, yellowish, inconspicuous; capillitium blackish, arising from the entire length of the columella, and forming a moderately dense network, with many free tips; spores blackish violet in mass, pale brownish

violet by transmitted light, somewhat irregularly spiny, 10–13 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Woods Hole, Massachusetts.

HABITAT: On mosses and lichens.

DISTRIBUTION: Maine, New Hampshire, Massachusetts, North Carolina, Ontario, Michigan.

ILLUSTRATIONS: Bot. Gaz. 18: pl. 20, f. 1-4; Lister Mycet, ed. 3. pl. 103, f. j; Macbr. & Martin, Myxom. pl. 12, f. 278, 279.

The transfer of this species from Comatricha to Diachea in 1907 was made without explanation, apparently on the basis of the more or less persistent translucent sporangium wall. This is more explicitly stated by G. Lister in the second edition of the monograph. The lack of lime in the hypothallus, stalk and columella seems to us to place this species, like C. cylindrica, in Comatricha, particularly as other species of Comatricha, notably the common C. typhoides, sometimes have an equally persistent peridium. The spores are not verrucose, as stated in the original and later descriptions, but distinctly spiny, the spines somewhat irregularly distributed.

Comatricha cylindrica (Bilgram) Macbr., N. Am. Slime-Moulds ed. 2. 173. 1922.

Diachaea cylindrica Bilgram, Proc. Acad. Phila. 57: 524. 1905.

Paradiachea cylindrica (Bilgram) Hertel, Dusenia 7: 349. 1956.

Sporangia gregarious or caespitose in small clusters, sessile, cylindric, silvery gray or bronze, iridescent, 1–2.2 mm tall, 0.3–0.5 mm in diameter; peridium membranous, persistent, especially below, hyaline, silvery-iridescent; hypothallus whitish, rugose; columella tubular, extending nearly to the apex, pale and semitranslucent near the base, elsewhere brown; capillitium a fairly dense network of brown threads with pale, slender tips; spores dark in mass, pale violaceous by transmitted light, incompletely verrucose-reticulate, 12–14 μ in diameter.

TYPE LOCALITY: Philadelphia, Pennsylvania.

HABITAT: Dead twigs and leaves.

DISTRIBUTION: New Hampshire, Ontario, Pennsylvania, Florida; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 103, a-e; Macbr. & Martin, Myxom. pl. 12, f. 280, 281; Hattori, Myxom. Nasu pl. 9, f. 6.

Like Comatricha caespitosa, to which it is closely related, C. cylindrica was originally referred to Diachea and both are listed under that genus in the Lister and Hagelstein monographs. Both are very similar to C. rispaudii, in which the sporangia are also sessile and with a persistent peridium. The spores of C. cylindrica are unique. The reticulations are incomplete and very irregular in size and are marked by lines of dark warts. There are in addition fainter warts in the meshes of the reticulum.

Comatricha dictyospora Čelak. f., Arch. Nat. Land. Böhmen 7(5): 49. 1893. Comatricha reticulata H. C. Gilbert, Am. Jour. Bot. 19: 140. 1932.

Stemonitis reticulata (H. C. Gilbert) Hertel, Dusenia 7: 346. 1956. Not S. reticulata Trent. 1797.

Sporangia scattered or gregarious in small, loose tufts, stipitate, erect, ovate to cylindric, 0.4–0.8 mm wide, dark lilac-brown, the total height 1.5–3

FIG. 174 Plate XIX

FIG. 162

Plate XVII

mm; stalk black, shining, less than half the total height, arising from a thin, silvery hypothallus; columella reaching to about three-fourths the height of the sporangium; capillitium rather dense, anastomosing and forming a net near but not at the surface, the free tips short, abundant; spores brown in mass, pale lilac-brown by transmitted light, rather faintly reticulate, 7–9 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Poland.

HABITAT: Rotten coniferous wood.

DISTRIBUTION: Poland; Ontario, Oregon.

ILLUSTRATION: Arch. Nat. Land. Böhmen 7(5), pl. 2, f. 9.

A. & G. Lister, Jour. Bot. 40: 211. 1902, said that this was *C. typhoides* var. heterospora Rex and this was repeated in the second edition of the Lister monograph. However, in the third edition (1925, p. 134), it was entered as a synonym of Stemonitis virginiensis, and *C. typhoides* var. heterospora was made a synonym of Stemonitis hyperopta.

Comatricha reticulata H. C. Gilbert was recognized by Macbride and Martin (1934) and by Martin (1949) on the basis of the description, since no specimen was available. Hagelstein (1944, p. 146) had earlier stated, on the basis of "authentic material," which may have been a syntype, that it was a form of Stemonitis virginiensis without a surface net. Krzemieniewska (1960, p. 176) reduced C. reticulata to synonymy under C. dictyospora. Since 1949, our very scanty isotype of C. reticulata has been found, and examination of it affords slight justification for Hagelstein's comment. It departs from the description in several respects, notably in the spores, which are rather pale, very faintly reticulate, and only $5-6~\mu$ in diameter. However we do have a specimen from Ontario, TRTC 902, and another believed to have been sent to Macbride by M. E. Peck from Oregon many years ago as C. suksdorfii, both of which agree satisfactorily with C. dictyospora.

Pending further information, the status of *C. reticulata* Gilbert must remain somewhat doubtful, but the available material suggests that Krzemieniewska was justified in making it a synonym of *C. dictyospora*.

FIG. 163 Plate XVII Comatricha elegans (Racib.) G. Lister, Guide Brit. Mycet. ed. 3. 31. 1909.

Rostafinskia elegans Racib., Rozp. Akad. Umiej. 12: 78. 1884.

Raciborskia elegans (Racib.) A. Berl., in Sacc. Syll. Fung. 7: 401. 1888.

Paradiacheopsis elegans (Racib.) Hertel, Dusenia 7: 348. 1956.

Sporangia gregarious or scattered, stipitate, globose or ovate, purplish or lilaceous brown, 0.3–0.5 mm in diameter, their total height 1–2 mm; peridium silvery, evanescent, rarely persistent; stalk long, slender, subulate, 0.8–1.6 mm in length; columella short, divided below the center of the sporangium, sometimes at or occasionally below the base, into several stout branches which give rise to the capillitium; capillitium rather loose, the threads flexuous, slender, anastomosing; spores reddish brown or pale reddish lilac in mass, pale violaceous brown by transmitted light, minutely punctate, 8–10 μ in diameter. Plasmodium watery white.

TYPE LOCALITY: Poland. HABITAT: Dead wood.

DISTRIBUTION: Europe; southern Asia, Japan; widely distributed in the United States; Costa Rica; West Indies, Brazil, Argentina.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 124, h-n; Hattori, Myxom. Nasu pl. 7, f. 2; Hagelst., Mycet. N. Am. pl. 11, f. 1, 2.

EXSICCATI: Brândză, Myxom. Roum. 44(IA).

Smaller and more reddish than *C. nigra*. The division of the columella into several stout branches seems constant and is strikingly distinctive when the spores are shed. *Orthotricha raciborskii* Čel. f., Arch. Nat. Land. Böhmen 54. 1893, is cited by G. Lister, Mycet. ed. 3. 144. 1925, as a possible synonym of this species on the basis of the description, but the specimen she saw appeared to be *C. nigra*. The description of *Paradiacheopsis curitibana* Hertel, Dusenia 5: 191. 1954, suggests that it may be this species, but, as Alexopoulos (1967) points out, it may represent a species of *Macbrideola*.

C. elegans var. microcarpa Meylan, Bull. Soc. Vaud. Sci. Nat. 58: 323. 1935, is said to be distinguished from the typical form by its much smaller size, the sporangia 0.2–0.3 mm in diameter and the globose capillitium with few or no free ends. Similar specimens have appeared from time to time in our cultures, always in scanty fruitings, but it seems possible that they represent a distinct species.

Comatricha fimbriata G. Lister & Cran, in G. Lister, Jour. Bot. 55: 122. 1917.

Paradiacheopsis fimbriata (G. List. & Cran) Hertel, Dusenia 7: 348. 1956.

Sporangia scattered, globose, stalked, fuscous, 0.1–0.35 mm in diameter, their total height under 1.5 mm; stalk black, subulate, fibrillose within, slender, straight, or curved, 0.4–1 mm high, entering the sporangium as a short columella; capillitium a scanty tuft of simple or forking purplish brown threads, free or with a few anastomoses, slender at the base but with many of the tips expanded; spores grayish purple, closely and minutely spinulose, paler and smoother on one side, (10-)11-12(-14) μ in diameter. Plasmodium colorless.

TYPE LOCALITY: Great Britain.

HABITAT: Bark of trees, especially when covered with *Protococcus*, dead coniferous wood, and woody stems. In the United States known mostly from developments in moist chambers.

DISTRIBUTION: Great Britain, Netherlands, Belgium, Greece; Massachusetts, New York, Maryland, Florida, Illinois, Iowa, Kansas, Texas, Arizona. ILLUSTRATIONS: Jour. Bot. 55, pl. 548, f. 2; Lister, Mycet. ed. 3. pl. 210, e-i.

The scanty capillitium, with the enlarged tips to the branches, the few or no anastomoses and the large dark spores are the marks of this minute species. The spores fall away so readily that old specimens or specimens shipped by mail may have only the stalks and naked capillitium present.

Nannenga-Bremekamp has recently described two new species which are obviously related to C. fimbriata, one of which may well be no more than an extreme variant of that species. C. solitaria Nann-Brem., Acta Bot. Neerl. 11: 31, f. 6. 1962, recently transferred to Paradiacheopsis as P. solitaria (Nann-Brem.) Nann-Brem., K. Ned. Akad. Wet. Proc. C. 70: 209. 1967, has a sparse capillitium with few or no anastomoses but without swollen tips. The species is reported from Scotland (Ing, 1967). Such sporangia may be found in collections of C. fimbriata. The spores are said to be 14-16(-18) μ in diameter, but when her drawings are checked with the accompanying scale, they measure 11-14 μ , which is too little above the usual range of C. fimbriata to be of great significance. The other species, C. longipila, with its ovate to cylindrical sporangia and small spores, has a capillitium somewhat resembling that of C. fimbriata but much more complex, with many anastomoses and few and less prominent swollen tips. It is here recognized.

C. erythropodia B. Ing, Trans. Brit. Mycol. Soc. 47: 54. 1964, recently transferred to Paradiacheopsis, as P. erythropoda (B. Ing) Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 70: 209. 1967, is very close to this species, but differs chiefly in its translucent, red-brown, fibrous stalk. It is thus far known only from Nigeria.

FIG. 164 *Plate* XVII Comatricha irregularis Rex, Proc. Acad. Phila. 43: 393. 1891.

FIG. 165 Plate XVIII Comatricha crypta (Schw.) Macbr., Bull. Nat. Hist. Univ. Iowa 2: 139. 1892. Comatricha longa var. irregularis (Rex) Lister, Mycet. 120. 1894.

Stemonitis irregularis (Rex) Hertel, Dusenia 7: 346. 1956.

Sporangia crowded in tufts, stipitate, cylindric, dark brown or nearly black, semi-erect or drooping, their total height 2–8 mm; stalk black, relatively long, one-third to one-half the total height; hypothallus well developed, continuous, shining, dark red or silvery; columella slender, flexuous, reaching the apex where it may be expanded; capillitium loose, open, forming a large-meshed net toward the center, with numerous hyaline free ends, appearing hoary when the spores are dispersed; spores black in mass, often agglutinated, dark brown by transmitted light, paler on one side, closely warted, 7.5–9.5 μ in diameter. Plasmodium white.

TYPE LOCALITY: Philadelphia, Pennsylvania.

HABITAT: Dead wood, often corticate, and usually of angiosperm trees.

DISTRIBUTION: Maine to Manitoba and Washington, south to Pennsylvania and Texas, and in Puerto Rico; ?Netherlands; India; Malaya; Japan; Australia.

ILLUSTRATIONS: Lister, Mycet. ed. 3. *pl.* 122, *f–h*; Macbr. & Martin, Myxom. *pl.* 12, *f.* 286, 287; Hattori, Myxom. Nasu *pl.* 7, *f.* 4.

EXSICCATI: Thaxter, Rel. Farl. 387.

The dense clusters of drooping sporangia, the open capillitium with coarse, dark, main branches and very delicate hyaline tips and the verrucose and smaller spores distinguish this species from the related *C. longa*. It is rather common in temperate North America, but less so elsewhere.

This species was reported by Macbride, Bull. Nat. Hist. Univ. Iowa 2: 139. 1892, under the name C. crypta Schw., obviously intended as a new combination based on Stemonitis crypta Schw., Trans. Am. Phil. Soc. II. 4: 260. 1832, and must, of course, be cited as such under the present rules. Morgan, Jour. Cinc. Soc. Nat. Hist. 16: 134. 1894, published it the same way, but Macbride, N. Am. Slime-Moulds 126. 1899, rejected the name on the ground that the identity of Schweinitz's species was uncertain and that the type was reported as lost. In any event, C. crypta (Schw.) Macbr. is inescapably tied to S. crypta Schw., and its identity must remain uncertain unless Schweinitz's type is found.

Comatricha laxa Rost., Mon. 201. 1874.

FIG. 166 Plate XVIII

Badhamia penetralis Cooke & Ell., Grevillea 5: 49. 1876.

Lamproderma ellisianum Cooke, Ann. Lyc. N. Y. 11: 397. 1877 (as ellisiana).

Comatricha macrosperma Racib., Rozpr. Akad. Umiej. 12: 76. 1884.

Comatricha ellisiana (Cooke) Ell. & Ev., N. Am. Fungi 2696. 1891.

Comatricha sommerfeltii A. Blytt, Forh. Vid.-Selsk. Christiania 1892(2): 8. 1892.

Stemonitis macrosperma (Racib.) Massee, Mon. 76. 1892.

Stemonitis laxa (Rost.) Massee, Mon. 79. 1892.

Comatricha ellisii Morgan, Jour. Cinc. Soc. Nat. Hist. 16: 133. 1894.

Sporangia scattered or gregarious, stipitate, subglobose, ovate or short-cylindric, erect, purplish or reddish brown, becoming paler as spores are shed; total height usually 1–3.5 mm, sometimes smaller; stalk black, shining, often short, usually less than half the total height, but in forms with globose sporangia reaching two-thirds the total height, tapering from an expanded base; columella

erect, rigid, usually reaching nearly to the summit, rarely shorter and forking in globose forms; capillitium open, arising from all parts of the columella, the primary branches more or less horizontal, with few anastomoses and many short, free tips; spores deep reddish brown in mass, grayish brown or lilaceous by transmitted light, minutely and irregularly warted, (7-)8-10(-11) μ in diameter. Plasmodium watery-white.

TYPE LOCALITY: Germany.

HABITAT: Dead wood and twigs and on bark in cultures.

DISTRIBUTION: Europe; Asia; temperate North America; Tahiti.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 124, a-g; Macbr. & Martin, Myxom. pl. 12, f. 288-290; Hattori, Myxom. Nasu pl. 7, f. 3.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2696, 3495; Jaap, Myxom. Exs. 114.

In its more common expression, the ovate reddish sporangia are very distinctive. As a rule, the stalks of a single fruiting are nearly uniform but there is great variation amongst different fruitings in this respect. The capillitium is scarcely lax although there are fewer anastomoses than in other species of similar size and shape. With this as a center, there are many variations which have been the basis for the establishment of named varieties and of the other species cited in the synonymy. The characters which are used to separate one from another seem highly inconstant. The variety rigida Brândză, Ann. Sci. Univ. Jassy 11: 126. 1921, recognized by G. Lister and by Hagelstein, recently transferred to Paradiacheopsis as P. rigida (Brândză) Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 7: 209. 1967, is said to have a scantier capillitium, less sinuous than in the typical form and with much larger spores, up to 13 μ in diameter. Species have been described on smaller differences. We have seen no specimens, but Hagelstein reports it from Minnesota. The varieties obovata Racib, and oblonga Racib, of C. macrosperma, both published by Raciborski with the original description of that species, refer to the ovate and short-cylindrical forms respectively. Since these merge into each other by imperceptible degrees, they are of dubious value. The variety microspora Meylan, Bull. Soc. Vaud. Sci. Nat. 46: 50. 1910, with spores mostly 4-6 μ, rarely larger, was later transferred to C. nigra as variety microspora Meylan, Ann. Cons. Bot. Genève 1913: 316. 1913, and still later raised to the status of a distinct species, C. fragilis Meylan, Bull. Soc. Vaud. Sci. Nat. 56: 70. 1925, with emphasis on the fugacious capillitium in addition to the small spores. It is reported from Scotland by Ing (1967). A collection from Meylan has spores 7-8 μ in diameter and a capillitium with no large branches, and seems closer to C. nigra than to C. laxa. A collection made by Hagelstein in 1935 and referred to C. fragilis, is an old weathered specimen consisting mostly of the bare stalks and columellae. It does have small spores, about 6 μ , but otherwise is past recognition. Hagelstein does not mention this species in his book (1944), so he evidently felt doubtful about the identification. Comatrichoides fragilis (Meylan) Hertel, Dusenia 7: 348. 1956 is based on this species, but, as noted, the genus is invalid. The original description of Badhamia penetralis Cke. & Ellis does not suggest this species, but Cooke based his new name Lamproderma ellisianum on the same specimen. Ellis and Everhart, in changing the name to Comatricha ellisiana, distributed as N. Am. Fungi 2696 a specimen collected by Wingate with the note "These specc. agree with specc. of Badhamia penetralis in my Herb. J.B.E." Our material of this number appears to belong here.

Comatricha longa Peck, Ann. Rep. N. Y. State Mus. 43: 70. 1890.

Stemonitis longa (Peck) Massee, Mon. 83. 1892.

Comatricha equinoctialis Torrend, Broteria 7: 78. 1908.

Sporangia crowded in dense masses, stipitate, deep fuscous or nearly black, cylindric, 10–50 mm long, the clusters depressed or pendent; stalks black

FIG. 167 Plate XVIII or dark red, shining, relatively short; hypothallus well developed, dark, shining; columella dark, slender, weak, attaining nearly to the apex; capillitium sparse, open, with a few anastomoses near the columella, elsewhere merely forking dichotomously, the branches free; spores blue-black in mass, dark brown by transmitted light, verrucose-reticulate, 8–10(–11) μ in diameter. Plasmodium yellow.

TYPE LOCALITY: New York. HABITAT: Dead wood.

DISTRIBUTION: New Hampshire to Ontario and Wisconsin and in Washington, south to Panama and the West Indies; South America; Great Britain, Netherlands, Germany, central Europe; Africa; southern and eastern Asia.

ILLUSTRATIONS: Ann. Rep. N.Y. State Mus. 43, pl. 3, f. 1–5; Lister, Mycet. ed. 3. pl. 122. a–e; Macbr. & Martin, Myxom. pl. 13. f. 303, 304; Hattori Myxom. Nasu pl. 7, f. 1.

EXSICCATI: Brândză, Myxom. Roum. 100(NY): 47(IA).

The very long sporangia, forming prominent black masses usually on large fallen logs, the extremely open capillitium and the distinctive spores make this species readily reconizable. It is closest to *C. irregularis*, from which it may be distinguished by the fuscous-black rather than brownish black color, the much longer sporangia with even more open net and the somewhat larger spores in which the warts are always arranged in a reticulate pattern and which are often, but not always, connected by delicate lines forming a true reticulation.

The species is not uncommon in eastern North America, but appears to be rare elsewhere.

Comatricha longipila Nann.-Brem. Acta Bot. Neerl. 11: 31. 1962.

FIG. 168
Plate XVIII

Sporangia cylindrical, obtuse, varying to ovate or subglobose, stipitate, clustered in small groups or scattered, up to 0.6 mm in diameter, total height up to 2 mm; peridium evanescent except for a small collar occasionally left at the base of the sporangium; columella tapering, attaining nearly the summit of the sporangial cavity; capillitium dark brown, somewhat lax, delicate, the branches tending to be parallel, with many anastomoses, sometimes enlarged at or below the long, slender tips which point outwards; spores dark brown in mass, pale reddish brown by transmitted light, minutely spinulose, 6.5–7 μ in diameter. Plasmodium watery white.

TYPE LOCALITY: Wolfhaze, Netherlands.

HABITAT: Dead wood.

DISTRIBUTION: Netherlands; known from several localities.

ILLUSTRATIONS: Acta Bot. Neerl. 11: 33, f. 5.

As noted under C. fimbriata, C. longipila appears to be closely related to that species, from which it is distinguished by the predominantly cylindrical sporangia with columella giving rise to the capillitium throughout the length, the small spores, and by the denser capillitium with numerous anastomoses and with branches often enlarged below the ends, bearing pointed tips beyond the enlargements.

Comatricha lurida A. Lister, Mycet. 119. 1894.

Paradiacheopsis lurida (A. Lister) Hertel, Dusenia 7: 348. 1956.

Collaria lurida (A. Lister) Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 70: 209. 1967.

FIG. 169 Plate XVIII

Sporangia gregarious, stipitate, globose, or short-ovoid, erect, purplish or lilaceous brown, 0.2–0.5(–0.7) mm in diameter, their total height 0.5–1.5 (–2.3) mm; peridium fugacious; stalk black, subulate, one-half to three-fourths the total height, arising from a scanty hypothallus; columella cylindric, short, rarely reaching to about half the height of the sporangium and divided at the tip into several stout branches which give rise to most of the capillitium; capillitium rather dark brown, not dense, with few anastomoses and many long, colorless free ends, arising mainly from the tip of the main branches of the columella; spores lilac-purple in mass, pale lilaceous gray under the lens, distinctly warted (6–)7–10 μ in diameter. Plasmodium white.

TYPE LOCALITY: Lyme Regis, England.

HABITAT: Dead leaves.

DISTRIBUTION: Great Britain, Norway, Portugal, Rumania; India; Japan; New York, Maryland, Ontario, Iowa; Colombia.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 127, a-c; Hagelst., Mycet. N. Am. pl. 3; Mycopathologia 28: 271, f. 4, f-i.

The distinctive feature of this species is the columella, giving off few and inconspicuous branches up to its tip, where it divides into two or more stout branches from which the bulk of the capillitium arises.

The species is very variable in size, usually rather small, especially when developed in moist chambers, but may be larger when collected in the field. Hagelstein's illustration, f. 2. of his pl. 3, does not show the striking appearance of the large branches as they occur in typical fruitings.

Both the Lister and Hagelstein monographs speak of the spores as "coarsely warted" and the illustrations show them as prominently warted. Singh and Pushpavathy (1966) describe the markings as "prominent pointed echinulations." Our material, including Hagelstein's 1120, shows the spores as distinctly, but scarcely coarsely, warted.

C. lurida and C. elegans are very similar, the differences mainly of degree rather than kind, and it may be that they should be united under the latter name, with the diagnosis suitably expanded.

Comatricha mirabilis Benjamin & Poitras, Mycologia 42: 515. 1950.

Sporangia bone-brown, in small clusters, erect, short-cylindrical to ovoid, stipitate, 0.25–0.35 mm in diameter; total height 0.7–1.5 mm; peridium quickly evanescent, except at the base, where it may persist as a small collar; hypothallus conspicuous, brown, more or less common to a cluster of sporangia; stipe about half the total height, brownish black, continuous into the sporangium as a columella which reaches nearly to the apex; capillitium lax, arising from the entire length of the columella, consisting of simple or dichotomous, rarely anastomosing, purple-black threads, slender and paler near the base, gradually expanding outwards and ending in short, much thickened, rigid, diverging branchlets which project beyond the surface of the sporangium; spores smoky yellow-brown, rather irregularly and coarsely reticulate with narrow raised bands, with about 20 meshes to the hemisphere, 10–13 μ in diameter (av. 11.1 μ) including the border, which is 1–2 μ high. Plasmodium unknown.

FIG. 171
Plate XVIII

TYPE LOCALITY: Urbana, Illinois.

HABITAT: Goat dung.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATION: Mycologia 42: 516, f. 1-4.

Although known only from the type area, the material is ample. This appears to be a distinctive species, entirely different from *C. cylindrica*, *C. rispaudii* and *C. dictyospora*, the other species with reticulate spores. The spores tend to cling together at maturity and the protruding tips of the capillitium may be seen clearly under a good binocular.

FIG. 172 Plate XVIII Comatricha nigra (Pers.) Schroet., Krypt.-Fl. Schles. 3(1): 118. 1885.

Stemonitis nigra Pers., in J. F. Gmel., Syst. Nat. 2: 1467. 1791.

Stemonitis atrofusca Pers., Neues Mag. Bot. 1: 91. 1794.

Stemonitis ovata Pers., Syn. Fung. 189. 1801.

Trichia mucoriformis Schum., Enum. Pl. Saell. 2: 211. 1803.

Stemonitis oblonga Fries, Syst. Myc. 3: 159. 1829.

Stemonitis obtusata Fries, Syst. Myc. 3: 160. 1829.

Comatricha obtusata (Fries) Preuss, Linnaea 24: 141. 1851.

Stemonitis friesiana de By., in Rab., Fungi Eur. 568. 1862.

Comatricha friesiana (de By.) Rost., Mon. 199. 1874.

Comatricha persoonii var. gracilis Čelak. f., Arch. Nat. Land. Böhmen 7(5): 51. 1893.

Comatrichoides nigra (Pers.) Hertel, Dusenia 7: 348. 1956.

Sporangia scattered or gregarious, stipitate, globose, ovate or short-cylindric, rarely prolate, erect, black or dark brown, becoming ferruginous when blown; total height 2–8 mm; stalk black, hair-like, relatively long, usually 2–6 times the length of the sporangium; hypothallus scanty, red, sometimes lacking; columella reaching to the middle or the upper part of the sporangium, there merging into the capillitium; capillitium intricate, the threads slender, flexuous, branching and anastomosing freely and forming a dense net; spores black in mass, dark violaceous by transmitted light, faintly warted to nearly smooth, (8-)9-10(-11) μ in diameter. Plasmodium colorless, then white.

TYPE LOCALITY: Germany.

HABITAT: Dead wood.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. *pl.* 123, *a*–*g*; Macbr. & Martin, Myxom. *pl.* 12, *f.* 297, 298; Hattori, Myxom. Nasu. *pl.* 7, *f.* 5.

EXSICCATI: Rab., Fungi Eur. 568; Jaap, Myxom. Exs. 32, 113; Brândză, Myxom. Roum. 46(IA); Thaxter, Rel. Farl. 388.

In its typical expression, C. nigra may be readily recognized by the dark, globose or ovate sporangia on long slender stalks, as beautifully illustrated in figures a and b of Lister's pl. 123, which also bring out the variation in size. Of the three varieties recognized in the Lister monograph, var. aequalis and var. subcaespitosa are here treated as species, as was done by Hagelstein. The var. alta (Preuss) G. Lister, based on Comatricha alta Preuss, Linnaea 24: 141. 1851, is described as having oblong or cylindrical sporangia with capillitium attached chiefly at the base of the columella. C. filamentosa Meylan, Bull. Soc. Vaud. Sci. Nat. 53: 456 [1920] 1921, said by Miss Lister to belong here, is the basionym for Comatrichoides filamentosa (Meylan) Hertel, Dusenia 7: 348. 1956. We have a number of specimens grading into such forms and a few, notably two from Washington

formerly referred to *C. pacifica*, which represent it exactly. If a fairly constant distinction can be found, it may be desirable to recognize *C. alta* as a good species, but that is not possible with the evidence at hand. See comment under *C. suksdorfii. C. friesiana* var. *oblonga* and var. *obovata* Rost., Mon. 200. 1874, refer to the elongate and ovate forms respectively. As there seems to be complete intergradation between the extremes, the varietal names are of no significance taxonomically.

Even as here restricted, *C. nigra* is a difficult and complex species. Some of the small forms still retained seem out of place in it and will probably have to be removed in the future. The same is true of at least some of the cylindrical fruitings referred to this species. This is a case where cultural studies would be helpful.

Comatricha nodulifera Wollman & Alexop., Can. Jour. Bot. 46: 157. 1968.

Sporangia solitary, stalked, brown, globose, 0.1–0.35 mm in diameter, total height 0.3–0.6 mm; peridium completely evanescent from an early stage; stalk up to 0.3 mm, about half of total height or shorter, fibrous, reddish brown, arising from a small, concolorous discoid hypothallus; columella attaining at least the middle of the sporangium; capillitium rather open, arising from the tip and sides of the columella, branching and anastomosing, its main branches dark, the ultimate ones pale with many minute, globular swellings about 1 μ in diameter; spores chocolate-brown in mass, violaceous brown by transmitted light, with many inclusions, finely and uniformly spinulose, 9.5–10.5 μ in diameter. Aphanoplasmodium colorless at first, later yellowish.

TYPE LOCALITY: Round Rock, Texas.

HABITAT: Bark in moist chamber culture. Description based on numerous sporangia produced on oak bark extract-corn meal agar.

DISTRIBUTION: Known only from the type locality. ILLUSTRATIONS: Can. Jour. Bot. 46: 158, pl. 1, 2.

The globular, nodule-like swellings on the capillitium, which have proved to be a stable character in culture on various natural as well as artificial substrata, make this species easy to recognize.

Comatricha pulchella (C. Bab.) Rost., Mon. App. 27, 1876.

Stemonitis pulchella C. Bab., Proc. Linn. Soc. 1: 32. 1839.

Comatricha persoonii Rost., Mon. 201. 1874.

Sporangia gregarious, sometimes crowded, stipitate, ovate to cylindric, acuminate, pale brown or ferruginous, total height 0.7–1.5(–3) mm; stalk black, usually shorter than the sporangium, rarely half the total height; hypothallus thin, membranous, either discoid and individual or forming a more or less continuous film under the colony; columella straight, tapering, reaching almost to the apex; capillitium dense, flexuous, dark brown, with many rather robust main branches which develop successively smaller, freely anastomosing branches and with few free ends; spores brown in mass, pale lilac-brown by transmitted light, minutely but uniformly punctate, 6.5–8 μ in diameter. Plasmodium watery white or colorless.

TYPE LOCALITY: England.

HABITAT: Dead wood and dead and living leaves.

DISTRIBUTION: Widely distributed in north temperate regions; New Zea-

land; Bolivia, Uruguay; Nigeria; southern Asia and Japan.

FIG. 173 Plate XVIII ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 126, a-e, i-l; Macbr. & Martin, Myxom. pl. 13, f. 301, 302; Hattori, Myxom. Nasu pl. 7, f. 6.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2094 (as C. gracilis Wingate), 3599.

The ferruginous color and the ovate to subcylindrical sporangia on moderately long stems mark this species. Both the Lister and Hagelstein monographs recognize two varieties, var. fusca A. Lister, Jour. Bot. 35: 215. 1879, with more rigid capillitium and brownish spores, and var. gracilis G. Lister, Mycet. ed. 2: 115. 1911, the latter based on Comatricha gracilis Wingate, issued, without description, in Ellis & Ev., N. Am. Fungi 2094, 1888. We have been unable to find a valid description of Wingate's species; lacking this, Wingate's name is a nomen nudum, but G. Lister's varietal name was, of course, validly published. Neither variety seems to be sharply marked.

Comatricha rigidireta Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 69: 352. 1966. Sporangia scattered, stipitate, dark brown, globose or subglobose, 0.2–0.6 mm in diameter, total height 0.6–1.5 mm; stalk subulate, black, shining and opaque above, brown below and seen by transmitted light to be composed of netted strands, these sometimes immersed at base in a translucent matrix arising from a circular hypothallus, the stalk continuing into the sporangium as a columella, which may terminate abruptly at the center of the sporangial cavity or extend in attenuated form to near the top; capillitium arising chiefly from the upper part of the columella, the threads dark, coarse, rigid, united into a close-meshed internal net with a few short free ends, and into a continuous net at the surface, sometimes scanty in small sporangia; spores dark brown in mass, violaceous by transmitted light, very minutely warted, 11-13(-16) μ in diameter. Plasmodium watery white.

TYPE LOCALITY: Amersfoort, Netherlands.

HABITAT: On bark from living *Taxodium* in moist chamber.

DISTRIBUTION: Known only from the original cultures.

ILLUSTRATIONS: K. Ned. Akad. Wet. Proc. C. 69: 353, f. 2.

The fibrous stalk, large spores and dark, rigid capillital network composed of coarse threads united at the surface to form a net with few and short free ends are the distinctive marks of this species. The small Comatrichas which appear in moist chambers are often extremely puzzling. This species may provide accommodation for some of them and is tentatively recognized to that end. C. elegans var. microcarpa Meylan is somewhat similar, but has a longer, more slender stalk and smaller spores.

FIG. 175 Plate XIX Comatricha rispaudii Hagelst., Mycologia 21: 297. 1929.

Paradiachea rispaudii (Hagelst.) Hertel, Dusenia 7: 349. 1956.

Sporangia densely clustered, sessile, cylindric or clavate, violaceous brown, 0.8–1.5 mm tall, 0.4–0.6 mm in diameter; peridium membranous, shining, iridescent, tending to persist, especially at the base, where it remains as a cup; columella dark brown, solid, stout below, becoming slender, sinuous, and irregular above, often dividing into two or three main branches near base, sometimes attaining the apex; capillitium brown, rather coarse, dividing freely, anastomosing sparsely, hence the meshes rather coarse; spores brown in mass, pale violet-brown by transmitted light, reticulate, with narrow ridges, the body 8–9 μ , with ridges, 10–11 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Albertson, New York.

HABITAT: Dead leaves and herbaceous stems.

DISTRIBUTION: New Hampshire, New York, Pennsylvania, Virginia, Florida; Japan.

ILLUSTRATIONS: Mycologia 21: pl. 26, f. 1-3; Hagelst., Mycet. N. Am. pl. 11, f. 5, 6; pl. 12, f. 1; Hattori, Myxom. Nasu ed. 2. pl. 23, f. 4.

This species is closely allied to C. caespitosa and C. cylindrica, from both of which it is distinguished by the browner color and the smaller spores. The three species form a natural unit which was recognized by Hertel when he grouped them together in his genus Paradiachea. Whether that genus should be recognized is a matter of taxonomic judgment, but in view of the not infrequent instances of persistent peridia in other species of Comatricha, it seems best at present to retain these species in Comatricha.

Comatricha rubens A. Lister, Mycet. 123. 1894.

Paradiacheopsis rubens (A. Lister) Hertel, Dusenia 7: 348. 1956.

Collaria rubens (A. Lister) Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 70: 209. 1967.

Sporangia gregarious, stipitate, globose, obovate or ellipsoid, 0.2–0.4 mm wide, erect, pinkish brown; total height 1–2 mm; peridium membranous, pinkish brown, persistent at the base as a cup with the capillitium attached; stalk black, shining, setaceous, rising from a circular, brown hypothallus; columella reaching one-half to two-thirds the height of the sporangium; capillitium arising from all parts of the columella, dense, flexuous and anastomosing, pinkish-brown, attached to the persistent lower portion of the peridium; spores pale pinkish-brown in mass, yellow-brown by transmitted light, minutely spinulose, 7–8 μ in diameter. Plasmodium watery white.

TYPE LOCALITY: Lyme Regis, England.

HABITAT: Dead leaves and bark.

DISTRIBUTION: Great Britain; Netherlands; Switzerland; Maine to Washington, Oregon, and Virginia, in widely scattered localities.

ILLUSTRATIONS: Lister, Mycet. ed. 3, pl. 127, d-f.

The bright color and the tendency of the base of the peridium to persist, with capillitium attached, distinguish this species from most of the other minute Comatrichas. C. elegans has a collar but the capillitium is quite different. C. rubens is said to be not uncommon in Britain but has rarely been collected elsewhere, possibly because it has been overlooked.

Comatricha subcaespitosa Peck, Ann. Rep. N. Y. State Mus. 43: 71. 1890.

Stemonitis subcaespitosa (Peck) Massee, Mon. 80. 1892.

Comatricha persoonii var. subcaespitosa (Peck) Torrend, Broteria 7: 77. 1908.

Comatricha nigra var. subcaespitosa (Peck) G. Lister, Mycet. ed. 3. 142. 1925. Comatricha nigra var. brachypus Meylan, Bull. Soc. Vaud. Sci. Nat. 56: 71. 1925.

Comatricha brachypus (Meylan) Meylan, Bull. Soc. Vaud. Sci. Nat. 57: 41. 1929.

Sporangia scattered, caespitose or clustered, stipitate, cylindric, obtuse, fuscous, becoming paler with age, the total height 1.5–3 mm; stalk black,

FIG. 176 Plate XIX

71.

FIG. 177
Plate XIX

rather short, one-fifth to one-fourth the total height; hypothallus silvery, usually inconspicuous; columella straight, reaching nearly to the apex; capillitium regular, rather dense, the main branches short, quickly giving rise to the flexuous, violaceous brown, secondary branches which anastomose freely forming a nearly complete net at the surface, with few free ends; spores dark purplish brown in mass, dusky under the lens, minutely warted, (7-)8-9(-10) μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Sandlake, New York.

HABITAT: Dead wood.

DISTRIBUTION: Nova Scotia to Ontario and Kansas, south to North Carolina, and in California; Costa Rica; England, Switzerland.

ILLUSTRATIONS: Ann. Rep. N. Y. State Mus. 43, pl. 3, f. 6–9; Macbr. & Martin, Myxom. pl. 12, f. 295, 296.

This species is very close to Stemonitis, but the general habit is that of a Comatricha and there are a few free ends to the capillitium at the surface. It seems to bear little relation to C. nigra, of which G. Lister called it a variety. Krzemieniewska (1960) recognizes C. brachypus as a valid species, but does not mention C. subcaespitosa. An authentic specimen of C. brachypus from Meylan shows no significant differences when compared with specimens of C. subcaespitosa. The sporangia are more acuminate, the stalks are somewhat longer and the spores slightly larger and more coarsely warted, but such variations seem to be too slight to justify specific recognition or even a varietal name.

Comatricha suksdorfii Ellis & Ev., Bull. Washburn Lab. Nat. Hist. 1: 5. 1894.

Stemonitis suksdorfii (Ellis & Ev.) Massee, Mon. 76. 1892.

Stemonitis nigra var. suksdorfii (Ellis. & Ev.) Sturgis, Colo. Coll. Publ. Sci. 12: 33. 1907.

Comatricha aequalis var. pacifica Macbr., N. Am. Slime-Moulds ed. 2. 181.

Comatricha pacifica Macbr., in Peck & Gilbert, Am. Jour. Bot. 19: 139. 1932. Stemonitis pacifica. (Macbr.) Hertel, Dusenia 7: 346. 1952.

Sporangia gregarious to densely aggregated on a dark brown or dull red hypothallus, black, becoming deep violaceous after spores are shed, cylindric or ovate to bluntly obovate, stalked; total height (2–)4–8 mm; stalks varying from rather short to half the total height or more; peridium silvery, usually evanescent, but not rarely persisting in flakes or sometimes as a whole; columella black, attaining tip of sporangium or nearly so, giving rise to a dense, dark capillitium, with frequent anastomoses and numerous, often pallid, free ends; spores black in mass, dark violaceous brown by transmitted light, usually paler on one side, distinctly warted, (9–)10–12(–13) μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Mt. Paddo, Washington.

HABITAT: Coniferous wood and debris.

DISTRIBUTION: Ontario, Colorado, Nevada, New Mexico, British Columbia, Washington, Oregon, California; Switzerland.

ILLUSTRATIONS: Macbr. & Martin, Myxom. pl. 12, f. 291. 292.

Hagelstein (1944), reported that the type collection of S. suksdorfii from Washington represents the long-stalked phase with comparatively small spores which has been referred to C. pacifica and this we confirm. Our numerous collections

FIG. 178 Plate XIX from the Rocky Mountains and the Sierras tend to have shorter stalks, more robust sporangia and larger and darker spores, but the intergradation appears to be complete. A few specimens in which the silvery peridium remains nearly intact show marked resemblance to *Lamproderma carestiae* (Ces. & de Not.) Meylan, from which they may be distinguished by the more elongate sporangia, with columellae which reach nearly to the tips, and with typical *Comatricha*-type branching.

Individual globose sporangia may occur in clusters of ovate or elongate sporangia but we have seen no fruitings containing more than a few such. Rather robust, long-stalked fruitings with ovate or short-cylindrical sporangia and much paler spores, formerly referred to what was called *C. pacifica* are probably better referred to *C. nigra* and may represent *C. alta* Preuss. At present we are unable to find clear distinction, as noted under *C. nigra*, between such forms and that species.

The description of the var. aggregata Meylan, Bull. Soc. Vaud. Sci. Nat. 53: 455. 1921, suggests forms which have developed in excessive humidity.

Comatricha tenerrima (M. A. Curt.) G. Lister, Guide Brit. Mycet. ed. 4. 39. 1919.

Stemonitis tenerrima M. A. Curt., Am. Jour. Sci. II. 6: 352. 1848.

Comatricha pulchella var. tenerrima (M. A. Curt.) G. Lister, Mycet. ed. 2. 156. 1911.

Sporangia scattered, stipitate, slender-fusoid, pale red, brownish pink or lilac-pink, the total height 1.5–2 mm; stalk slender, black, usually longer than the sporangium; columella slender, often reaching the summit; capillitium flexuous, netted, branched, with few or no large branches, pale red; spores pale flesh-colored, minutely warted, (6.5–)7–8 μ in diameter. Plasmodium watery white.

TYPE LOCALITY: South Carolina.

HABITAT: Dead wood, herbaceous stalks and leaves.

DISTRIBUTION: Quebec, Pennsylvania, South Carolina, Iowa; Antigua; Brazil; Europe; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 126, f-h.

EXSICCATI: Jaap, Myxom. Exs. 156 (as C. pulchella var tenerrima).

Distinguished from *C. pulchella*, of which the second edition of the Lister monograph regarded it as a variety, by its pinkish color, long stems and distinctly fusoid sporangia, well shown in Lister's fig. 126, f.

S. tenerrima Berk. & Curt., Grevillea 2: 69. 1873, was described there as new and is so cited by Berlese and G. Lister. It appears to be identical with what Curtis originally described.

Comatricha typhoides (Bull.) Rost., in Lister, Mycet. 120. 1894.

Stemonitis typhina Wiggers, Prim. Fl. Holsat. 110. 1780.

Trichia typhoides Bull., Hist. Champ. Fr. 119. 1791.

Stemonitis typhoides (Bull.) DC., Fl. Fr. 2: 257. 1805.

Stemonitis leucopoda Fries, Symb. Gast. 16. 1817.

Comatricha typhina (Wiggers) Rost., Mon. 197. 1874.

Comatricha affinis Rost., Mon. 202. 1874.

Comatricha stemonitis Wettst., Verh. Zool.-Bot. Ges. Wien 35: Abh. 534. 1886.

Stemonitis affinis (Rost.) Massee, Mon. 76. 1892.

Stemonitis atra Massee, Mon. 78, 1892.

FIG. 180 Plate XIX

FIG. 181 Plate XIX Stemonitis carlylei Massee, Mon. 84. 1892.

Stemonitis platensis Speg., Anal. Mus. Nac. Buenos Aires 6: 202. 1898.

Sporangia gregarious or scattered, stipitate, cylindric or narrowly ovate, obtuse or slightly narrowed above, erect or arcuate, bone brown, 0.2–0.6 mm in diameter, the total height 2–5 mm; peridium silvery, tardily fugacious, sometimes persisting in patches or rarely entirely, frequently as a shallow cup at base of spore chamber; stalk dark red to nearly black, paler at base, often covered with a silvery film, about half the total height, sometimes shorter, continuing into the sporangium as the tapering columella; capillitium a dense network of pale brown threads, with numerous anastomoses, the free ultimate branchlets short, delicate, hypothallus distinct, reddish brown, often continuous; spores rich lilac-brown in mass, pale by transmitted light, faintly punctate and with a few scattered clusters of dark warts, 6–8 μ in diameter. Plasmodium white.

TYPE LOCALITY: France.

HABITAT: Rotten wood; sometimes on leaves. DISTRIBUTION: Cosmopolitan and common.

ILLUSTRATIONS: Bull., Herb. Fr. pl. 477, f. 2; Lister, Mycet. ed. 3. pl. 125, a-c, k-m; Macbr. & Martin, Myxom. pl. 12, f. 293, 294; Hattori, Myxom. Nasu pl. 15, f. 1; Hagelst., Mycet. N. Am. pl. 15, f. 8.

EXSICCATI: Jaap, Myxom. Exs. 13, 49; Brândză, Myxom. Roum. 60(NY); 45(IA).

This extremely common species often occurs in extensive fruitings and is usually readily recognized. In occasional collections, the peridium persists almost as in a *Lamproderma*; more frequently it persists as an inconspicuous cup at the base of the sporangium.

Rex, Proc. Phila. Acad. 43: 367. 1893, described a var. heterospora with spores 5–6 μ in diameter and with a very delicate reticulation, visible only under high magnification, in addition to the larger warts. The variety similis G. Lister, Mycet. ed. 2. 152. 1911, is said to possess an imperfect surface net below and to lack the silvery sheath on the stem. The variety cinerea Hertel, Dusenia 6: 48. 1955, is described as dark gray in color. The variety microspora A. Lister, Mycet. 121. 1894, is now included in Stemonitis microsperma Ing.

Rostafinski (1874) based his combination on S. typhina as used by Roth, 1788. But Roth cited the same combination as previously used by Wiggers in 1780 and by Willdenow in 1783, hence the citation must be (Wiggers) Rost. It is true that the early application of these names was very vague and that they were frequently applied incorrectly, but a good nomenclatural case could probably be made for the priority of C. typhina (Wiggers) Rost., which was widely used prior to 1894, over the validation of Rostafinski's informal transfer of C. typhoides in his Versuch 7. 1873, as validly published by A. Lister in 1894. Macbride, N. Am. Slime-Moulds 130. 1899, adopted the combination C. stemonitis (Scop.), attributing it to Sheldon, 1895, but Wettstein had used it some years earlier. Mucor stemonitis Scop., Fl. Carn. ed. 2. 2: 493. 1772, is the basionym of C. stemonitis Wettst. cited above. Schaeffer, Fung. Bav. 4: 133, pl. 297. 1774, adopted Scopoli's name but, as pointed out by G. Lister, Mycet. ed. 3. 146. 1925, the application of Scopoli's name is doubtful. Schaeffer's illustrations might represent several species of Stemonitis as well as C. typhoides.

C. typhina var. pumila Rost., Mon. 199. 1874, is described as very small. It may have been based on "Stemonitis pumila Corda," which Rostafinski cites as a synonym of C. typhina. Corda, Ic. Fung. 5: 59. 1842, proposed no such species but merely referred his material doubtfully to S. pumila Fries, Syst. Myc. 3: 159. 1829, which is also of doubtful identity.

EXCLUDED AND DOUBTFUL SPECIES AND VARIETIES

Comatricha elegans var. microcarpa Meylan, Bull. Soc. Vaud. Sci. Nat. 58: 323. 1935.

Neither the description nor the accompanying figure suggest C. elegans. The variety may well represent a distinct species.

Comatricha extendens Hagelst., Mycologia 27: 374. 1935.

This curious form, lacking a columella, and with an elastic capillitium, was first found on wet flooring near steam pipes, growing at 90–100° F. The description suggests an abnormal development. In Mycet. N. A. 163. 1944, Hagelstein reports finding later developments connecting it with *C. nigra* through *C. elegans*. All were from the type locality. Its status as a species is extremely doubtful.

"Comatricha obtusata A. Lister," Mycet. 117. 1894. Cited in the second and third editions of the Lister monograph. Not validly published. A. Lister cited Preuss as author of the name.

PHYSARALES

Macbride, N. Am. Slime-Moulds ed. 2. 22. 1922.

Spores black, deep purplish or violaceous brown in mass; deep purplish brown to violaceous by transmitted light; lime present, usually abundant, in peridium, capillitium or stalk, sometimes in any two or all of these, never restricted to stalk, columella and hypothallus alone; capillitium of thread-like or tubular filaments throughout, or bearing limy nodes; peridium usually limy; assimilative stage a phaneroplasmodium.

The Physarales are distinguished by the usually abundant lime in some and often all parts of the fructification. Diachea has a limy stalk, columella and hypothallus and for that reason is included here in the Lister and Hagelstein monographs. However, in every other respect it appears to be closely related to Comatricha and Lamproderma and it is therefore placed with those genera in the present treatment. Leptoderma was formerly included in the Physarales, but the lime present is so scanty and restricted that it has seemed preferable to include it in the Stemonitales, close to Diacheopsis.

KEY TO FAMILIES

 Capillitium calcareous, usually intricate; entire fructification often limy, the lime in the form of non-crystalline granules.

Physaraceae

 a. Capillitium non-calcareous or rarely bearing aggregations of crystalline lime; peridium, and often stipe, limy, the lime frequently crystalline.

Didymiaceae

Physaraceae

Rost. Versuch 9. 1873 (as tribus).

Capillitium netted, calcareous, very rarely nearly limeless, composed of calcareous tubes of nearly uniform diameter, of calcareous nodes connected by slender, hyaline tubules, or of a combination of these and other characters; peridium usually limy; spores black, deep violaceous or dark gray in mass, deep purplish brown to violaceous brown or pale violaceous by transmitted light.

The generic distinctions in the Physaraceae are not always sharp. Four of the genera here recognized are monotypic, but even though the characters by which they are distinguished are not fundamental, they are readily recognizable to the naked eye and remarkably constant. *Physarum*, by far the largest genus in the Myxomycetes, displays a wide range of forms, and many attempts have been made to divide it into smaller genera, but none of these has proved to be practicable. It merges into *Badhamia*, as noted under that genus, and also into *Craterium* and *Fuligo*, but in practice, these genera are usually readily recognizable and it seems best to maintain them until we possess further knowledge of their developmental morphology.

There are many plasmodiocarpous species, but the majority are sporangiate.

However, many sporangiate species may, under certain circumstances, fruit as plasmodiocarps. In such cases there are nearly always sporangia present and there is often a complete series of transitions from the sporangia to the plasmodiocarps.

Fuligo is the only consistently aethalioid genus. Even so, occasional fruitings of Fuligo approach the sporangial condition while a few species of Physarum, notably P. gyrosum, may in their fruitings suggest aethalia, but the resemblance is at most superficial.

KEY TO GENERA

- a. Capillitium duplex, i.e., composed of two distinct systems.
- a. Capillitium essentially homogenous.
 - b. Primarily plasmodiocarpous, but sometimes
 fruiting as pulvinate sporangia or massed
 into a pseudoaethalium; capillitium of
 limy plates, massed transversely, connected
 with a nearly limeless network of
 slender tubes bearing numerous, often hooked spines.

 Cienkowskia
 - o. Primarily sporangiate, if plasmodiocarpous, then usually accompanied by sporangia; capillitium not spinose. c
- c. Sporangia ovate; peridium smooth, shining; capillitium a limy network, connected with and interpenetrating a limeless net of flattened tubules.

 Leocarpus
- c. Sporangia deeply introverted, thimble-like,
 rarely plasmodiocarpous; peridium rough;
 capillitium composed of stout calcareous spines
 arising from the inner wall and a network of
 slender threads bearing a few calcareous nodes.

 Physarella
 - d. Capillitium a network of calcareous tubes of nearly uniform diameter; limeless connecting tubules few or none.

 Badhamia
 - d. Capillitium a network of hyaline limeless tubules with calcareous nodes at many or all of the junctions.
- e. Fructification an aethalium; pseudocapillitium
 present, often more conspicuous than capillitium.

 Fuligo
- e. Fructification sporangiate or plasmodiocarpous, rarely approaching aethalioid; pseudocapillitium lacking.
 - f. Plasmodiocarpous, cylindrical, pendent,
 often anastomosing to form a 3-dimensional net.

 Erionema
 - f. Sporangiate or plasmodiocarpous,
 rarely pendent; plasmodiocarps, when
 anastomosing, forming a 2-dimensional net.
- g. Sporangiate; dehiscence circumscissile, often by a preformed lid, the lower portion persisting as a deep cup. Craterium
- g. Sporangiate or plasmodiocarpous, rarely somewhat aethalioid; dehiscence irregular or lobate; lower portion of peridium remaining as at most a shallow, irregular cup.

 Physarum

Cienkowskia

Rost., Versuch 9. 1873. Not *Cienkowskia* Regel & Rach, 1858, nor *Cienkowskya* Solms, 1867.

Willkommlangia O. Kuntze, Rev. Gen. Pl. 3(1): 875. 1891.

Fructification primarily plasmodiocarpous, the plasmodiocarp often massed to form a pseudoaethalium, or less commonly broken up into pulvinate spor-

b

d

angia, irregularly dehiscent; peridium cartilaginous, more or less densely encrusted with lime; capillitium duplex, of angular, flattened nodes massed transversely into plates tending to divide the plasmodiocarp into segments, and slender, anastomosing threads forming a loose or dense net, bearing a few calcareous nodes and numerous short, sharp-pointed, often uncinate branchlets; spores dark in mass.

Type species, Physarum reticulatum Alb. & Schw.

Cienkowskia Rost. is a later homonym of the two earlier generic names proposed for vascular plants and Kuntze was justified in proposing his new name. However, according to the Kew Index, the earlier is a genus dubium and the later was both a synonym and a homonym from the beginning. Neither appears to have been used for many years and Cienkowskia Rost. has been very widely used for nearly a century as a genus of Myxomycetes.

A single species.

FIG. 200

Plate XXII

Cienkowskia reticulata (Alb. & Schw.) Rost., Mon. 91. 1874.

Physarum reticulatum Alb. & Schw., Consp. Fung. 90. 1805.

Diderma reticulatum (Alb. & Schw.) Fries, Syst. Myc. 3: 112. 1829.

Fructification primarily plasmodiocarpous, 0.3–0.5 mm in diameter, the reticulations often so closely massed as to form a pseudoaethalium, or sometimes broken into pulvinate, sporangium-like units; peridium hyaline, pale yellow to red or dark reddish brown, often encrusted with white, orange or red lime granules, the lime sometimes densely aggregated as an outer peridial wall, the color varying from deep maroon to white with red spots, transversely rugulose, closely applied to the substratum; capillitium duplex, consisting of flat, angular, limy nodes massed into transverse plates which divide the interior into incomplete segments, and a delicate network of yellowish tubules bearing a few rounded calcareous nodes and numerous spiny, often uncinate, branches; spores black in mass, violaceous brown by transmitted light, minutely roughened, (7-)8-10(-11) μ in diameter. Plasmodium orange to scarlet.

TYPE LOCALITY: Germany.

HABITAT: Dead wood.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATION: Lister, Mycet. ed. 3, pl. 70; Macbride and Martin, Myxom. pl. 7, f. 143–145; Hagelstein, Mycet. pl. 8, f. 6 (pseudoaethalium).

This moderately common species is extremely variable but rather readily recognizable in all its forms. The red spots characteristic of many fruitings, especially the paler ones, are referred to in the Lister monograph as "waxy" but that probably refers only to their appearance, not their nature. After the rupture of the peridium, the contents tend to emerge as elongate strands of capillitium and spores in which the plate-like appearance of the limy capillitium is very striking. The inner wall is thicker at the base and often persists after the spores and capillitium have been dissipated. When the wall is bright colored, the bases become very conspicuous.

DOUBTFUL SPECIES

Cienkowskia transiliensis Golovenko, in Frunze, Izdet. Akad. Nauk Kirghiz 1960: 131. 1960. Nomen nudum.

A white, plasmodiocarpous species with limy peridium but limeless capillitium. The Russian description does not suggest a *Cienkowskia*. Not validated by a Latin diagnosis.

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Leocarpus

Link, Ges. Nat. Freunde Berlin Mag. 3: 25. 1809.

Triptotrichia Corda, Ic. Fung. 1: 22. 1837.

Sporangiate; peridium brittle, of three layers, a thin, cartilaginous outer layer, a thick middle calcareous layer and a membranous inner layer to which the capillitium is attached; capillitium duplex, consisting of a network of limy tubes resembling that of *Badhamia*, connected with, but mostly distinct from, a nearly limeless network of flattened tubules, expanded at the junctions; columella lacking; pseudocolumella often present; spores black in mass.

Type species, Diderma vernicosum Pers.

A single species.

Leocarpus fragilis (Dicks.) Rost., Mon. 132. 1874.

Lycoperdon fragile Dicks., Pl. Crypt. Brit. 1: 25. 1785.

Lycoperdon parasiticum With., Brit. Pl. ed. 2. 3: 464. 1792.

Diderma vernicosum Pers., Ann. Bot. Usteri 15: 34. 1795.

Trichia lutea Trent., in Roth, Catalecta Bot. 1: 230. 1797.

Lycogala parasiticum (With.) With., Brit. Pl. ed. 4. 4: 372. 1801.

Spumaria ramosa Schum., Enum. Pl. Saell. 2: 195. 1803.

Physarum nitidum Schum., Enum. Pl. Saell. 2: 205. 1803.

Physarum vernicosum (Pers.) Schum., Enum. Pl. Saell. 2: 206. 1803.

Reticularia fragilis (Dicks.) Poir., in Lam. Encyc. 6: 183. 1804.

Leocarpus spermoides Link, Ges. Nat. Freunde Berlin Mag. 3: 25. 1809.

Leocarpus vernicosus (Pers.) Link ex Nees, Syst. Pilze Schw. 115. 1816.

Leocarpus atrovirens Fries, Symb. Gast. 13. 1817.

Leocarpus parasiticus (With.) S. F. Gray, Nat. Arr. Brit. Pl. 1: 574. 1821.

Leangium vernicosum (Pers.) Fries, Stirp. Fems. 83. 1826.

Leangium atrovirens (Fries) Fries, Stirp. Fems. 83. 1826.

Diderma atrovirens (Fries) Fries, Syst. Myc. 3: 103. 1829.

Diderma ramosum (Schum.) Fries, Syst. Myc. 3: 105. 1829. Not Diderma? ramosum Pers. 1801.

Tripotrichia elegans Corda, Ic. Fung. 1: 22. 1837.

Leocarpus ramosus (Schum.) Fries, Summa Veg. Scand. 450. 1849.

Liceopsis jurensis Meylan, Bull. Soc. Vaud. Sci. Nat. 53: 459. 1921.

Sporangia gregarious or clustered, short-cylindric or obovate to subglobose, stipitate or sessile on a constricted base, 0.6–1.6 mm in diameter, total height 2–4 mm, pale yellow or ochraceous to chestnut or deep maroon; peridium smooth, shining, brittle, of three layers, the outer cartilaginous, the middle calcareous, the inner membranous, hyaline; stalk usually present, weak, whitish or yellow, forming an extension of the membranous hypothallus; capillitium duplex, consisting of a network of rigid, white, calcareous nodes connected with but largely distinct from a network of slender, colorless, flattened tubules, usually notably expanded at the junctions; spores black in mass, brown under the lens, with a paler area at one side, coarsely warted (11–) 12–14(–16) μ in diameter. Plasmodium orange-yellow.

TYPE LOCALITY: Germany.

HABITAT: Dead leaves, twigs, rotten wood, and sometimes living herbaceous plants.

FIG. 201 Plate XXII DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Nees, Syst. Pilze Schw. pl. 9, f. 110: Rostafinski, Mon. pl. 6, f. 93; Lister, Mycet. ed. 3. pl. 82; Univ. Iowa Stud. Nat. Hist. 14(8), pl. 3, f. 20; Nat. Geogr. Mag. 49(4) pl. 1; Hattori, Myxom. Nasu pl. 11, f. 3.

EXSICCATI: Rav., Fung. Car. 78; Ellis, N. Am. Fungi 1123; Sydow, Myc. Germ. 1400; Jaap, Myxom. Exs. 8, 66, 88, 103; Brândză, Myxom. Roum. I. 1: 10; II. 1: 28(NY); 19(IA); Hintikka, Myxogast. Fenn. 9a, b; Thaxter, Rel. Farl. 404.

A common, variable, but very distinctive species. The smooth, shining, extremely fragile sporangia, often clustered on twigs, suggest a mass of insect eggs. Under a hand lens or binocular microscope a broken sporangium with its prominent limy capillitium showing sharply against the black spore mass suggests a *Badhamia*. Under such circumstances the hyaline portion of the capillitium is difficult to see. Also, the extreme fragility of the peridium extends to the capillitium, so that unusual care must be used in making microscopic mounts. Despite these difficulties, and the great variation in color and shape, the species is readily recognizable at sight.

Lister speaks of the sporangium wall as composed of two layers, regarding the limy shell as deposited inside the outer layer and part of it. Rostafinski, in the drawing cited, and Baker, in the figure in the Iowa Studies, regard it as triple. This, we believe, is correct and easily demonstrated.

Liceopsis jurensis Meylan is cited as a synonym on the authority of G. Lister, Mycet. ed. 3. 81. 1925, as "L. jurana." She regards it as based on a somewhat irregular development of L. fragilis.

EXCLUDED AND DOUBTFUL SPECIES

Leocarpus melaleucus Mont., Ann. Sci. Nat. Bot. IV. 3: 140. 1855.

Cited incorrectly by Berlese, in Sacc. Syll. Fung. 7: 347, 1888, as "L. mela-leucus Gay" and as a synonym of P. sinuosum (Bull.) Rost., P. bivalve of the present treatment.

Leocarpus minutus (Schum.) Fries, Summa Veg. Scand. 451. 1848.

Based on Spumaria minuta Schum., Enum. Pl. Saell. 2: 196, 1803. Cited by G. Lister, Mycet. ed. 3. 61. 1925, as doubtful synonym of *Physarum conglomeratum*.

Leocarpus nitens Fries, Summa Veg. Scand. 450. 1848.

Cited by Berlese, in Sacc., Syll. 7: 371. 1888, as possible synonym of *Chondrioderma difforme* (Pers.) Rost., *Didymium difforme* of the present treatment. Possibly based on *Diderma nitens* Klotzsch ex Berk., in Smith, Engl. Fl. 5(2): 311. 1836.

Physarella

Peck, Bull. Torrey Club 9: 61. 1882.

Sporangia cylindric or cupulate, introverted, hence thimble-shaped or bell-shaped, borne on a hollow stalk, sometimes sessile or plasmodiocarpous; peridium firm, membranous, more or less encrusted with lime; capillitium duplex, consisting of stout, calcareous spines borne on the inner surface of the exterior walls and penetrating into the interior, and a delicate network of nearly limeless tubules, bearing a few fusiform calcareous nodules; spores dark in mass.

Type species, Physarella mirabilis Peck.

In describing the genus *Physarella*, in a combined generic and specific description, Peck stated that he had at first regarded the species as an aberrant species of

Physarum and "made it known under the name Physarum mirabile." This clearly implies previous publication of such a name, but we have been unable to find such. If it was published, that should be designated as the type. Pending discovery of such publication, the type must be indicated as Physarella mirabilis, which is, of course an obligate synonym of "Physarum mirabile Peck," if such name exists.

The original publication, as cited, was in May, 1882. The genus and species were also published in Rev. Mycol. 4: 172. July, 1882, and this has been cited as the original publication.

A single species.

Physarella oblonga (Berk. & Curt.) Morgan, Jour. Cinc. Soc. Nat. Hist. 19: 7. 1896.

FIG. 202 Plate XXII

Trichamphora oblonga Berk. & Curt., in Berk., Grevillea 2: 66. Nov. 1873.

Physarum rufibasis Berk. & Br., Jour. Linn. Soc. 14: 85. Dec. 1873.

Chondrioderma inflatum Rost., Mon. 425. 1875.

Tilmadoche oblonga (Berk. & Curt.) Rost., Mon. App. 13. 1876.

Tilmadoche hians Rost., Mon. App. 14. 1876.

Physarella mirabilis Peck, Bull. Torrey Club. 9: 61. 1882.

Perichaena pseudoaecidium Speg., Ann. Soc. Cient. Arg. 22: 187. 1886.

Physarum hians (Rost.) Massee, Mon. 296. 1892.

Physarella lusitanica Torrend, Bull. Soc. Port. Sci. Nat. 2: 66. 1908.

Sporangiate, stalked, gregarious, varying to sessile or plasmodiocarpous; sporangia cylindrical, usually nodding, deeply infundibuliform or cup-shaped, up to 1 mm in diameter, and to 3 mm in total height; peridium greenish or colorless, flecked with yellow, brown or red, or occasionally white, limy scales which may be sparse or may form a nearly continuous limy crust; dehiscence from above, the outer portion rupturing irregularly or in more or less lobate fashion, the segments becoming reflexed, exposing the spikes of the limy capillitium and leaving the spineless inner peridial walls protruding as a cylindrical tubular pseudocolumella; stalk, when present, terete or flattened, hollow, usually long, red, translucent, arising from an inconspicuous hypothallus; capillitium duplex, composed of limy, spine-like, simple or more or less branched processes arising from the inner walls of the outer part of the peridium and a dense network of slender, violaceous threads bearing a few fusiform, yellow or white calcareous nodes; spores globose, violet-brown, punctate, $(6-)7-8~\mu$ in diameter. Plasmodium yellow or white.

TYPE LOCALITY: Pennsylvania.

HABITAT: Dead wood and leaves.

DISTRIBUTION: Throughout temperate and tropical North America; widely distributed in the tropics of both hemispheres; rare in Europe.

ILLUSTRATIONS: Rost., Mon. App. f. 243; Bull. Torrey Club 9, pl. 24, f. 7; Lister, Mycet. ed. 3. pl. 71; Univ. Iowa Stud. Nat. Hist. 14(8); pl. 3, f. 21; Macbr. & Martin, Myxom. pl. 10, f. 223-225.

EXSICCATI: Ellis, N. Am. Fungi 1212, 1399.

This striking species, when fully developed, looks like nothing else. The thimble-shaped sporangium and, after opening, the limy spikes protruding from the inner surface of the outer peridium, and the tubular inner peridium protruding as a pseudocolumella make it unmistakable. Plasmodiocarpous fruitings are not rare, but are usually accompanied by the typical sporangiate forms. Even when this is not the case, the characteristic spines are conspicuous. Dr. Farr has examined the type of *Perichaena pseudoaecidium* and finds it to be this species.

A white variant with yellow stalks and white plasmodium has been collected from two localities in Jamaica and from Pakistan. One of the Jamaica strains has been grown in culture by Alexopoulos and has proved to be consistent under such conditions, suggesting that it is an albino mutant. This is a case where a subspecific name is justified, and it may properly be cited as *P. oblonga* f. alba Alexop., Mycologia 56: 553. 1964.

G. Lister, Mycet. ed. 3. 73. 1925, cites *P. lusitanica* as a doubtful synonym. However, *P. oblonga* has now been cultured extensively and variations similar to those stressed by Torrend in Broteria 7: 1908 (p. 173 of reprint) have been observed in such cultures.

Badhamia

Berk., Trans. Linn. Soc. 21: 153. 1853.
Scyphium Rost., Mon. 148. 1874.

Sporangiate, sessile or stalked, varying to somewhat plasmodiocarpous; peridium thin, varying from nearly limeless to thickly encrusted; capillitium a network of calcareous tubules, the nodes little or not at all enlarged, sometimes with a few, and sometimes with many hyaline, limeless tubules, then approaching *Physarum*; stipe, when present, varying from membranous and little more than an extension of the hypothallus, to stout and well-formed; columella present or absent; spores black in mass, free or adherent in clusters.

Type species, Sphaerocarpus capsulifer Bull.

As here defined, Badhamia merges imperceptibly into Physarum. As originally defined by Berkeley it was restricted to species with clustered spores. Berkeley believed that each cluster was originally encased in a vesicle, which disappeared at maturity. He recognized six species, B. hyalina (now regarded as a synonym of B. capsulifera), B. utricularis, B. capsulifer, B. nitens, B. pallida (now considered a synonym of B. nitens), and B. fulvella, of which the identity is uncertain. The three species B. capsulifera, B. utricularis and B. nitens, plus B. versicolor, B. papaveracea and B. populina, constitute a coherent generic group. Of the remaining species, some have a typical badhamioid capillitium in some collections while in others which are regarded as representing the same species, the capillitium is very uneven, with large angular nodes connected by slender limy strands and sometimes some of the latter are limeless, as in Physarum. Since there are certain species of *Physarum* with a very similar capillitium, it has been suggested that some of these species should be transferred to Physarum. Farr (1961) has recently returned Badhamia decipiens to Physarum, to which it was originally referred, and her disposition is followed in this treatment. It may be that this should be done with other species, but only after detailed study of ample material.

KEY TO SPECIES

 Spores formed in clusters, these sometimes breaking apart at maturity; capillitium strongly badhamioid, lacking hyaline connecting threads.

Ъ

 Spores free; capillitium varying from typical badhamioid to somewhat physaroid, with a few short, hyaline connecting threads.

g

 Spore clusters very loose, readily falling apart; spores globose, uniformly warted or nearly so.

B. utricularis

Spore clusters tending to persist;
 spores elliptical or ovate, with warts
 or spines on exposed outer
 surfaces, these scanty or lacking elsewhere.

С

c.	Spore clusters composed of 10-40 spores, the larger clusters hollow; sporangia flesh-colored to dingy white.	B. versicolor
c.	Spore clusters usually smaller, not hollow.	d
	d. Sporangia yellow, orange or greenish, fading to dingy	B. nitens
	d. Sporangia white, gray or	
	iridescent, rarely with rosaceous tints.	P mamanagasa
e.	Sporangia borne on firm, dark, usually short stalks.	B. papaveracea
e.	Sporangia sessile or on pale, weak, membranous stalks.	f
	f. Walls thin, translucent, sometimes almost	D agnowlifera
	limeless; exposed area of spores uniformly warted.	B. capsulifera
	f. Walls calcareous, white or sometimes with purplish or rosaceous tints; exposed area of	
	spores irregularly warted, the warts tending	
	to be in lines; sporangia large, densely	
	clustered or heaped, often resembling an aethalium.	B. populina
g.	Capillitium represented by tubular calcareous	
	columns, simple or forked, extending from base to peridiur	n. B. ainoae
g.	Capillitium netted, varying from	•
	typically badhamioid to somewhat physaroid.	h
	h. Sporangia with bright green or yellow tints.	i
	h. Sporangia without bright green or yellow tints.	j
i.	Sporangia stalked, yellowish green or	D. what I are an a
	gray with a yellow base; capillitium badhamioid.	B. viridescens
i.	Sporangia pulvinate or plasmodiocarpous, rarely stalked; green, often	
		hysarum decipiens
	j. Spores elliptical with a low	
	longitudinal ridge; sporangia pulvinate or	
	plasmodiocarpous, dingy or somewhat ochraceous.	B. ovispora
	j. Spores globose or subglobose, without longitudinal rid	lge. k
k.	Columella or pseudocolumella cylindrical,	
	rarely lacking; base of peridium tending to	
	persist as a cup; stipitate or sessile on a constricted base; sporangia dark gray to purple-brown.	B. obovata
1.		B. obocana
k.	Columella lacking or represented by a thickened base; rarely cupulate; sporangia paler to white.	1
	l. Lime scanty, peridium delicate, more or	•
	less iridescent; capillitium always badhamioid.	m
	l. Lime usually abundant, coating peridium	
	thickly; capillitium often appearing physaroid.	n
m.	Sporangia usually stalked, the stalks	
	hyaline, often long, slender, weak; peridium smooth.	B. utricularis
m.	Sporangia usually sessile, rarely stalked, the stalks short, yellowish.	B. foliicola
		B. Joincoid
	n. Spores dark, somewhat oval, encircled by a pale band; sporangia sessile.	B. dearnessii
	n. Spores globose, not encircled by a	
	pale band, or very inconspicuously so.	o
о.	Spores warted, with very open	
	overlying reticulation; usually stalked,	_
	the stalk often more than half the total height.	B. gracilis
О.	Spores rarely with overlying reticulation;	
	usually sessile or, if stalked, stalks short, rarely attaining half total height.	
	stand short, rately attaining than total neight.	p

p. Sporangia subglobose, small, sessile on a broad base, usually under 0.5 mm in diameter, densely crowded, drab to lilaceous, pinkish or white; peridium poreclain-like, smooth or somewhat rugose.

B. lilacina

 Sporangia usually larger, without drab or lilaceous tints; peridium not poreclain-like.

_ .

q. Sporangia densely heaped, pure white or ashy-white, stalked or sessile; stalks, when present, weak, strand-like.

B. cinerascens

 Sporangia gregarious or sometimes crowded, but not heaped, often colored below.

r. Spores lilaceous or violaceous by transmitted light, nearly smooth.

q

r. Spores dark by transmitted light, distinctly warted or spinulose.

t

s. Sessile or stalked; hypothallus prominent, red; stalk, when present, red; base of sporangium often reddish.

B. panicea

s. Always stalked; hypothallus inconspicuous, dark; stalk black or dark brown; base of sporangium brown.

B. iowensis

t. Spores densely and irregularly verrucose; stalk, when present, yellowish or brown except at darkened base; sporangia never orbiculate.

B. macrocarpa

t. Spores densely spinulose; stalk, when present, black; sporangia often orbiculate.

B. affinis

Badhamia affinis Rost., Mon. 143. 1874.

FIG. 203 Plate XXII

Badhamia orbiculata Rex, Proc. Acad. Phila. 45: 372. 1893.

Sporangia gregarious, often crowded or caespitose, subspherical to discoid, often depressed in the center and umbilicate below, sessile or short-stipitate, or plasmodiocarpous, 0.3–1 mm broad, pale gray or whitish, usually with a darker base; peridium membraneous, with flake-like, scanty or abundant incrustations of lime, sometimes rugulose; stalk, when present, short, dark, plicate, 0.1–1.7 mm tall; capillitium delicate, often denser at the center, white, the nodes often somewhat expanded; spores black in mass, deep violet-brown by transmitted light, closely and densely spinulose, $(12-)13-15(-17)~\mu$ in diameter. Plasmodium creamy-white.

TYPE LOCALITY: Chile.

HABITAT: Bark, often mossy, of living and dead trees.

DISTRIBUTION: Chile, Brazil, Galapagos; Great Britain, Rumania, Greece; Canada; Japan; widely distributed and common in the United States. ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 8, d-f; Hattori, Myxom. Nasu pl. 5, f. 3.

Most collections from the United States represent what has been called B. orbiculata, in which the sporangia are sessile or very short-stalked, flattened and depressed above and below. In the first edition of the Lister monograph, A. Lister reduced this to synonymy with B. affinis, but G. Lister, Mycet. ed. 3. 16. 1925, recognized it as var. orbiculata (Rex) G. Lister, stating, however, that a single collection may show complete intergradation between the typical form and the variety. Macbride always regarded it as distinct, influenced doubtless by the consistency of its appearance in collections from the central United States. This was maintained by Macbride and Martin (1934) but Martin (1949) reverted to A.

Lister's usage. Many collections do show this gradation, with clear evidence that all are products of a single plasmodium, hence the varietal name appears superfluous. This is a case where cultural studies might be helpful.

Badhamia armillata Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 69: 347, 1966, is based on specimens with rather scanty lime, differing from B. affinis in the somewhat larger spores, described as (15-)17-18(-19) μ in diameter, with a faint pale band partially encircling them. Our measurement of spores from a syntype makes them slightly smaller, (15-)16-17(-18) μ . We have specimens of B. affinis in which the spores approach this size very closely and some of them show similar pale bands. It may be questioned whether the differences are sufficient to warrant recognition of these forms as a distinct species.

Badhamia ainoae Yamashiro, Jour. Sci. Hiroshima U. Ser. B. 2: 3: 28. 1936 (as ainoi).

FIG. 366 Plate XLI

Sporangiate to plasmodiocarpous, the sporangia flattened, pulvinate or lenticular on a somewhat constricted base, circular in outline, 0.4–1 mm in diameter, grading into elongate sporangia or small plasmodiocarps rarely exceeding 1.5 cm in length, white or, when lime is scanty, dark brown; peridium single, membranous, colorless, translucent, shining; lime granules, when present, conspicuously clustered, often scanty, especially above; columella lacking; capillitium represented by tubular calcareous columns, simple or forked, extending from base to peridium; spores dark brown in mass, violaceous brown by transmitted light, minutely warted, 9–11 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Kyushu, Japan. HABITAT: Bark of living trees.

DISTRIBUTION: Southern Japan; Kentucky, Tennessee, Kansas, California. ILLUSTRATIONS: Jour. Sci. Hiroshima U. Ser. B. 2. 3: 28, f. 1; pl. 3, f. 1, 2.

A most unusual species, not at all similar to any other Badhamia and perhaps worthy of recognition as the type of a distinct genus. Whether the type or any of the other specimens mentioned in the original description are still extant is not known, but Dr. Travis E. Brooks has found it abundantly on the bark of living Juniperus virginiana in the first three states mentioned, and Dr. Kowalski in the last. The description here given is somewhat altered from the original on the basis of this material.

As is pointed out in the original description, the columnar pillars of lime suggest those of *Didymium sturgisii* Hagelst., except that the lime is not crystalline. In the Kentucky collections there are clusters of crystalline lime in the base, apparently imbedded in the hypothallus. These are not mentioned in the original description. They suggest the crystalline lime found in the base of *Leptoderma iridescens*.

Badhamia capsulifera (Bull.) Berk., Trans. Linn. Soc. 21: 153. 1853.

Sphaerocarpus capsulifer Bull., Hist. Champ. Fr. 139. 1791.

Physarum hyalinum Pers., Syn. Fung. 170. 1801.

Trichia capsulifer (Bull.) DC., Fl. Fr. 2: 254. 1805.

Physarum capsuliferum (Bull.) Chev., Fl. Paris 1: 339. 1826.

Physarum botryoides var. hyalinum Fries, Stirp. Fems. 83. 1826.

Badhamia hyalina (Pers.) Berk., Trans. Linn. Soc. 21: 153. 1853.

Badhamia varia Massee, Mon. 319, in part. 1892.

Sporangia clustered or gregarious, in small colonies, globose or obovoid, 0.5–1.5 mm in diameter, sessile or plasmodiocarpous or occasionally with weak

FIG. 204 Plate XXII strand-like stalks, grayish or greenish white from spores within, pure white when empty; peridium thin, translucent, covered with a limy network; stalk, when present, yellow or straw-colored, repent; capillitium white, open, scarcely expanded at the nodes; spores black in mass, purplish brown by transmitted light, adhering in firm clusters, mostly of 6–20, broadly ovate, warted or bluntly spiny on the exposed surface, elsewhere smooth or nearly so, $11-14~\mu$ in diameter. Plasmodium chrome-yellow.

TYPE LOCALITY: France.

HABITAT: Bark of dead limbs, sometimes while still attached to the tree.

DISTRIBUTION: Europe; Maine to California, south to Tennessee and Virginia; India; Japan; Australia.

ILLUSTRATIONS: Bull., Herb. Fr. pl. 470, f. 2; Lister, Mycet. ed. 3 pl. 3, a-c. EXSICCATI: Jaap, Myxom. Exs. 62, 161; Brândză, Myxom. Roum. III. 1: 2; 122(NY);66(IA).

In this species, as in similar Badhamias, the peridium and capillitium are extremely fragile, and when the peridium breaks, the capillitium and spores quickly fall out. The capillitium is best seen in an occasional sporangium in which this has not happened. The capillitium is very difficult to mount and preserve on a slide.

The var. repens G. Lister, Essex Nat. 18: 319. 1918, is based on slender plasmodiocarpous fruitings and the var. arborea G. Lister, Mycet. ed. 3. 10. 1925, on forms with small sporangia and rather large spores, both occurring on living trees. Neither seems to represent more than expected variation within the species limits. The varieties "genuina," subsessilis and gracilis of B. hyalina, all listed by Rostafinski, Mon. 140. 1874, appear to belong here, and are based on minor differences. See Berlese in Sacc., Syll. 7: 332. 1888.

Badhamia cinerascens Martin, Jour. Wash. Acad. 22: 88. 1932.

Sporangia globose or distorted by pressure, sessile or borne on a pallid, membranous stalk, 0.7–1.5 mm in diameter, densely aggregated and more or less superimposed, the peridial walls more or less fused, approaching a pseudoaethalium; hypothallus pale, membranous; peridium thin, fragile, ashy, bearing a white limy crust arranged in a somewhat reticulate pattern; columella none; capillitium abundant, white, strongly badhamioid as seen by binocular, but with a few limeless tubules when examined under the compound microscope; spores black in mass, dark purple-brown by transmitted light, spherical or nearly so, free, minutely but distinctly and irregularly spinulose, with patches of darker and larger spines and clearer areas of lighter and smaller spines, 12-14(-15) μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Medellin, Colombia.

HABITAT: On tree trunk.

DISTRIBUTION: Known only from the type collection. ILLUSTRATIONS: Jour. Wash. Acad. 22: 90. f. 1, 2.

Hagelstein (1944) regarded this as a synonym of *Physarum reniforme* (Massee) G. Lister, which, as noted elsewhere, is a very dubious species better included in *P. compressum*, at least in part. He also included *P. nicaraguense* as a synonym of the same species, which seems quite out of the question.

The delicate walls of the densely aggregated white sporangia, the striking capillitium, which is typically badhamioid despite the occasional limeless threads, and the dark, irregularly spinulose spores are the marks of this distinctive species.

Badhamia dearnessii Hagelst., Mycologia 34: 117. 1942.

Sporangia scattered or in small clusters, globose to subglobose, 0.5–1 mm in diameter, sessile on a narrow base, grayish white; peridium membranous, with deposits of white lime granules often arranged in vein-like fashion, or nearly limeless and iridescent; capillitium a delicate network of slender tubes sparsely charged with lime, sometimes nearly limeless and appearing pale yellow; spores free, globose, minutely and closely spinulose, purplish brown by transmitted light, encircled by a narrow pale band, (11-)12-14(-16) μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Quebec.

HABITAT: Dead twigs and branches of spruce.

DISTRIBUTION: Maine, Quebec.

ILLUSTRATIONS: Mycologia 34: 117; Hagelst. Mycet. N. Am. pl. 7, f. 1.

In our portion of the type, the capillitium is very delicate, but uniformly thickened. The spores are smaller than as described by Hagelstein, rarely exceeding 13 μ in diameter. A substantial number of them are somewhat oval, often apiculate at one end or, less commonly, at both ends. The pale band is readily seen on most of the spores and seems always to run through the apiculi when these are present.

Badhamia foliicola A. Lister, Jour. Bot. 35: 209. 1897.

Badhamia alpina G. Lister, Jour. Bot. 52: 99. 1914.

Sporangia gregarious or crowded, sessile or stipitate, subglobose or ellipsoid, 0.5–0.6 mm in diameter, or forming short plasmodiocarps, iridescent, gray; peridium thin, rugulose, sparingly calcareous, white or hyaline when empty; stalk, when present, short, yellowish, weak; capillitium a uniform network of slender, delicate, limy or nearly limeless tubes; spores free, yellowbrown by transmitted light, minutely warted, 11–12 μ in diameter. Plasmodium yellowish white to yellow or orange.

TYPE LOCALITY: Essex, England.

HABITAT: Plant debris.

DISTRIBUTION: Sweden and Ireland to Portugal and Rumania; Massachusetts to Washington, south to New Jersey and California; Australia.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 11.

EXSICCATI: Jaap. Myxom. Exs. 142, 162; Brândză, Myxom. Roum. 85(IA).

G. Lister discusses B. alpina and B. foliicola in the reference cited. She says in Mycet. ed. 3, p. 13, that B. alpina, known from Sweden and Ireland, is distinguished from B. foliicola "by the pale colour of the plasmodium, the more hemispherical sporangia and the pale nearly smooth spores." We have not seen authentic material but do not believe the characters named are sufficient to justify specific distinction, especially since similar variations in other species may be observed when they have developed in varied habitats.

The chief distinctions of *B. foliacola* are the rather small size of the sporangia, the scanty lime in the peridium and capillitium and the apparently completely free spores. Hagelstein (Mycet. N. A., p. 20) says of the spores "rarely loosely

clustered" but we have not observed this in our mounts.

FIG. 205 Plate XXII

FIG. 206 Plate XXII FIG. 207 Plate XXIII Badhamia gracilis (Macbr.) Macbr., in Macbr. & Martin, Myxom. 35. 1934.

Badhamia macrocarpa var. gracilis Macbr., N. Am. Slime-Moulds ed. 2. 37. 1922.

Sporangia gregarious or clustered, globose or ovate, umbilicate below, 0.5–0.7 mm in diameter, stipitate or sessile, rarely plasmodiocarpous, white or gray; peridium thin, translucent, pure white, sparsely flecked with white, calcareous nodules; stalk, when present, weak, thin, delicate, pale straw-yellow or pinkish, sulcate, more or less twisted, usually short but sometimes as much as twice the height of the sporangium; capillitium delicate, the tubes of uniform diameter throughout except at the center, where they may be massed; hypothallus scanty, pale yellowish; spores free, globose or somewhat angular, dark brown, closely and irregularly warted, usually with clusters of darker warts, and with a very coarse network of 1–6 meshes to the hemisphere covering the surface, 12–16 μ in diameter. Plasmodium white.

TYPE LOCALITY: Leyden, Colorado.

HABITAT: Dead stems of Yucca and cacti, not rarely on bark.

DISTRIBUTION: New York to Washington, south to Louisiana and Arizona; Panama; the West Indies; Galapagos; England; Paraq.

ILLUSTRATIONS: Macbr. N. Am. Slime-Moulds ed. 2. pl. 2, f. 9; Macbr. & Martin, Myxom. pl. 3, f. 37, 38.

This species is characterized by the rather small sporangia with delicate capillitium, sessile or with pale, weak stalks and by the very coarse reticulation overlying the closely warted spores. Hagelstein regarded the reticulation on the spores as no more than "pressure ridges" formed by contraction of the spores on drying. However formed, they are consistently present in this species and only occasionally so in others.

In many collections the sporangia appear to be sessile and sometimes are, but often the stalks are repent on the substratum or hidden under the umbilicate base of the sporangium.

Some of the specimens from the United States east of Kansas, which have been referred to *B. gracilis* on the basis of this spore character, suggest other species in other respects, notably *B. macrocarpa* and *Physarum compressum*, and it may be that such spores do occur in these species. We have typical collections from Kansas, Colorado, Nevada, New Mexico, Arizona, Puerto Rico, Panama and the Galapagos.

Badhamia iowensis Macbr., N. Am. Slime-Moulds ed. 2. 36. 1922.

Sporangia gregarious or scattered, stalked, globose or somewhat depressed, ashy white, with a brown cupulate base, 0.4–0.6 mm in diameter, up to 0.8–1.2 mm in total height; peridium gray, bearing large flakes of white lime, separated or more or less united; stalk short, cylindrical, rarely exceeding half the total height, black or very dark brown; hypothallus inconspicuous, somewhat thickened at the expanded base of the stalk; capillitium dull yellowish to white, the meshes irregular and somewhat physaroid but with very few limeless tubules; columella none but interior of cup-like peridium brown and somewhat thickened; spores black in mass, violaceous by transmitted light, minutely verrucose, the warts clustered in patches, making darker areas, $(10-)11-12~\mu$ in diameter. Plasmodium unknown.

TYPE LOCALITY: Blackhawk Co., Iowa.

HABITAT: Underside of fallen logs, apparently oak. DISTRIBUTION: Known only from type locality.

This species has been greatly misunderstood. G. Lister, Mycet. ed. 3. 40. 1925, cited it as a synonym of *Physarum auriscalpium* and this was copied in N. Am. Flora I(1): 107. 1949. At that time no specimens were available. Since then, five boxes have been found, which may represent no more than two or three collections. One of these, collected by Dr. Parish in Blackhawk County in 1920, and labelled "Badhamia iowensis Macbr." in Macbride's hand, is designated as the type. The membranous peridium, dotted with large limy squamules, is like that of *P. auriscalpium*. The capillitium, with its large angular nodes also suggests the capillitium of that species, but is much more badhamioid, even the slender branches being packed with lime granules with very few empty. It is much more badhamioid than is that of *B. panicea*, e.g. Farr, Mycologia 51: 598. 1959, decided it was a form of *Physarum pusillum*, but since, in correspondence, has questioned that decision. It seems, after comparison with these and other species, to fit in none of them, and it is therefore maintained as distinct.

The original description mentions reddish forms. None of our specimens shows any trace of red.

Badhamia lilacina (Fries) Rost., Mon. 145. 1874.

Physarum lilacinum Fries, Syst. Myc. 3: 141. 1829.

Craterium lilacinum (Fries) Massee, Mon. 271. 1892.

Physarum concinnum Massee, Mon. 308. 1892.

Sporangia gregarious to crowded, globose or obovate, 0.4-0.5(-0.6) mm in diameter, sessile or rarely with a short, stalk-like base; peridium double, the outer layer calcareous, crustose, smooth, drab, pinkish or pale lilac-brown to white, the inner layer thin, membranous, colorless, closely appressed; capillitium dense, white, strongly nodulose but with few or no limeless threads, often aggregated in the center as a pseudocolumella; hypothallus thin, transparent, continuous; spores free, black in mass, dark violaceous brown by transmitted light, covered with rough warts and ridges, subreticulate, 12–15 μ in diameter. Plasmodium white, changing to bright yellow before fruiting.

TYPE LOCALITY: Femsjö, Sweden.

HABITAT: Leaves, moss, and wood in swampy places.

DISTRIBUTION: Europe; New England to Ontario and Iowa; New Mexico.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 13.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2494; Thaxter, Rel. Farl. 380.

The drab or pinkish colors, the porcelain-like, or rarely somewhat roughened outer peridium and the subreticulate spores distinguish this species.

A var. megaspora Nann.-Brem., Med. Bot. Herb. Mus. Utrecht 150: 784. 1958, is described by Nannenga-Bremekamp as differing from the typical form of the species in the much larger spores, $15-20~\mu$, which are darker with lower, smaller and much more numerous warted ridges. If these differences prove to be constant, perhaps the variety should be given specific rank.

Badhamia macrocarpa (Ces.) Rost., Mon. 143. 1874.

Physarum macrocarpon Ces., Flora 38: 271. 1855.

Sporangia scattered or crowded, globose, subglobose, or subannulate, varying to subplasmodiocarpous, 0.5–1 mm in diameter, sessile or stipitate; peridium rugose, white above, often yellowish or brownish below, sometimes nearly limeless; stalk, when present, yellowish or brown, darker at base, furrowed and erect or submembranous and recumbent; hypothallus scanty;

FIG. 208 Plate XXIII

FIG. 209 Plate XXIII capillitium limy, with large nodes, often somewhat physaroid; spores spherical, free, black in mass, usually rather dark violaceous brown by transmitted light, finely but densely and somewhat irregularly verruculose, 11–15 μ in diameter. Plasmodium white or yellow.

TYPE LOCALITY: Germany.

HABITAT: On decaying fungi, dead wood and bark, and plant debris.

DISTRIBUTION: Europe; Maine to Ontario, south to North Carolina and Kansas; South America; Asia.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 8, a-c; Hattori, Myxom. Nasu pl. 5, f. 4.

EXSICCATI: Klotzsch, Herb. Viv. Myc. 1968 (type); Jaap, Myxom. Exs. 82; Brândză, Myxom. Roum. 92(NY).

This species seems to be much less common in North America than in Europe. The capillitium appears more physaroid under a binocular than in a mount. The large nodes with the narrower connecting limy tubes do approach the physaroid condition but do not quite attain it. The spores in some collections, otherwise typical, are pale brown by transmitted light.

If Klotzsch No. 1968 was published with a description earlier than the publication in Flora, that becomes the proper citation. Rab., Fungi Eur. 1968, cited by Berlese, in Sacc., Syll. 7: 330, has not been seen.

Badhamia nitens Berk., Trans. Linn. Soc. 21: 153. 1853.

FIG. 210 *Plate* XXIII Badhamia pallida Berk., Trans. Linn. Soc. 21: 153. 1853.

Badhamia inaurata Currey, Trans. Linn. Soc. 24: 156. 1863.

Badhamia alexandrowiczii Rost., Mon. 146. 1874.

Didymium reticulatum Berk. & Br., Jour. Linn. Soc. 15: 83. 1876. Not D. reticulatum Rost. 1874.

Lepidoderma reticulatum (Berk. & Br.) Massee, Mon. 252. 1892.

Sporangia gregarious or closely crowded, sessile or with weak, procumbent, strand-like stalks, globose or depressed-globose, 0.5–1 mm in diameter, or plasmodiocarpous, yellow, greenish yellow, or dull green, or, in forms with scanty lime in the outer peridium, iridescent; peridium double, the hyaline, iridescent inner layer tending to be more persistent than the fragile, opaque, somewhat rugose, pigmented outer layer; capillitium yellow or dull orange to dingy white; delicate, somewhat thickened at the nodes and then approaching physaroid; spores in compact clusters of 4–20, mostly 6–12, violaceous brown, coarsely warted on the exposed area, more finely warted elsewhere, pyriform, $12-14 \times 11-13~\mu$. Plasmodium yellow.

TYPE LOCALITY: Essex, England.

HABITAT: Dead wood and bark and on the bark of living trees, associated with mosses and lichens.

DISTRIBUTION: Western and central Europe; Michigan, Colorado, Washington, Oregon, California; the West Indies; southern and eastern Asia; South Africa.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 5.

Of the two recognized species of *Badhamia* with clustered spores and bright colored peridium and capillitium, *B. nitens* is distinguished from *B. versicolor* by its larger size, more compact clusters of fewer spores, and yellow or orange capillitium. We have two specimens from A. Lister, one with a rough, somewhat dull

yellow peridium and capillitium and the other with a delicate, thin, bright yellow peridium and concolorous capillitium. Our best American collection, from Washington, probably collected by Suksdorf, is very similar to the latter. Our other collections, all from the western United States, are duller.

The var. reticulata (Berk. & Br.) G. Lister, Trans. Brit. Mycol. Soc. 5: 71. 1914, is said to be plasmodiocarpous, with spores less densely clustered and less markedly "crowned." We have some Iowa collections referred to this variety, but it is doubtful whether they belong in B. nitens. Lister's variety is based on Didymium reticulatum Berk. & Br., which is a later homonym of D. reticulatum Rost., now regarded as a synonym of Diderma effusum. In his description of Lepidoderma reticulatum, Massee cites Didymium reticulatum Berk. & Br. and Licea reticulata Berk. & Br., both Jour. Linn. Soc. 14: 86. 1873, as synonyms. The latter, which must be the basionym of Berkeley's combination, is now believed to be a synonym of Perichaena vermicularis.

B. nitens is apparently a rare species, especially in North America.

Badhamia obovata (Peck) S. J. Smith, in Martin, Brittonia 13: 112. 1961.

Physarum rubiginosum Chev., Fl. Paris 1: 338. 1826. Not P. rubiginosum Fries, 1817.

Craterium obovatum Peck, Bull. Buff. Soc. Nat. Sc. 1:64. July, 1873.

Didymium curtisii Berk., Grevillea 2: 65. Nov. 1873.

Scyphium rubiginosum (Chev.) Rost., Mon. 148. 1874.

Scyphium curtisii (Berk.) Rost., Mon. 149. 1874.

Badhamia dictyospora Rost., Mon. App. 4. 1876.

Badhamia curtisii (Berk.) Rost., Mon. App. 5, 1876.

Badhamia rubiginosa (Chev.) Rost., Mon. App. 5, 1876.

Craterium rubiginosum (Chev.) Massee, Mon. 270. 1892.

Craterium dictyospermum Massee, Mon. 270. 1892.

Craterium curtisii (Berk.) Massee, Mon. 272. 1892.

Badhamia subaquila Macbr., N. Am. Slime-Moulds 64: 1899.

Sporangia gregarious or scattered, often forming extensive fruitings, obovoid, 0.5–0.7 mm in diameter, grayish or purplish brown, stipitate or sessile on a restricted base, total height 1–2 mm; peridium thin, brittle, paler and somewhat calcareous above, more persistent and darker below, the base, often clearly delimited as a cup, merging into the stalk; stalk erect, usually about half the total height of the sporangium or more, sometimes prolonged as a columella into the sporangium for up to two-thirds of the total height, or replaced by a pseudocolumella; capillitium dense, white or pale brown, radiating from the columella when that is present; hypothallus dark, thin, continuous or netted, beneath the colony; spores dark brown in mass, dark violet or purple-brown by transmitted light, moderately to strongly warted, often verrucose-reticulate to reticulate, variable in size in different collections but mostly 13–17 μ in diameter. Plasmodium yellow.

TYPE LOCALITY: France.

HABITAT: Rotten wood and plant debris; common.

DISTRIBUTION: Europe; temperate North America; Uruguay; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 14; Hattori, Myxom. Nasu pl. 5, f 6

EXSICCATI: Ellis, N. Am. Fungi 1215; Jaap, Myxom. Exs. 2, 64, 83, 143; Thaxter, Rel. Farl. 382.

FIG. 211 *Plate* XXIII As here defined, this species includes Badhamia rubiginosa var. dictyospora A. Lister, Mycet. 35. 1894, characterized by having "spores marked with prominent and often confluent warts forming a broken recticulation," and var. globosa A. & G. Lister, Jour. Bot. 42: 130. 1904, in which the sporangia are subglobose and the spores strongly reticulate and warted. The characters of the variety dictyospora merge into those of other collections and it would be difficult to delimit them. The variety globosa is represented in our material by parts of two collections, both from Wales, one of which was distributed as Jaap No. 143. Not only the spores, but the other characters suggest that this might well be regarded as a distinct species. Many species have been erected and maintained on less striking differences from related forms.

G. Lister (Mycet. ed. 2, 39. 1911) cites Diderma hookeri Berk., Fl. N. Z. pt. 2, 191, 1855, Lamproderma hookeri (Berk.) Rost. Mon. App. 24. 1876, Diachea hookeri (Berk.) Massee, Mon. 260. 1892, and Chondrioderma hookeri (Berk.) A. Lister, Mycet. 85, 1894 as possible synonyms of the variety globosa. All of these combinations are based on Berkeley's name. Massee (1892) says the spores are minutely warted. A. Lister (1894) calls them spinose. Neither term describes the spores of var. globosa. In view of what all three editions of the Lister monograph say about the condition of the original specimen, Berkeley's name and the other names based upon it should be regarded as of uncertain application.

There is certainly a distinction between the upper and lower portions of the peridium, and the latter does tend to remain as a cup and the capillitium does tend to be aggregated in the center, much as in *Craterium*. This is the basis for Rostafinski's genus *Scyphium*, which is certainly no more arbitrary than some other accepted genera, but it seems, like them, unnecessary, and Rostafinski evidently thought the same in 1876. Massee's reference of the species to *Craterium* in 1892 is equally understandable.

Badhamia subaquila Macbr. is based on a collection from Maine with broadly sessile sporangia massed on a dense hypothallus and with dark, densely warted spores, $14-15~\mu$, bearing very open and irregular reticulation over the warts. It may prove to be as distinct as it appears, but until further collections are made it may be retained here.

Badhamia ovispora Racib., Rozp. Akad. Umiej. 12: 72. 1884.

FIG. 212 Plate XXIII Sporangia usually small, 0.2–0.5 mm in diameter, sometimes larger, up to 1.2 mm, crowded or gregarious, sessile on a broad base, depressed-globose or forming short, rarely branched, plasmodiocarps, white to pale ochraceous; peridium double, the outer layer thick, densely limy, nearly smooth to rugose, the inner layer membranous, hyaline; capillitium white, dense, irregular, somewhat physaroid, tending to be massed in center where it may form a pseudocolumella; spores free, pale purple-brown under a lens, smooth, ellipsoid, with a low longitudinal ridge, 10– 13×8 – 10μ . Plasmodium unknown.

TYPE LOCALITY: Poland.

HABITAT: Wood, straw, and dung.

DISTRIBUTION: Great Britain, Germany, Poland; Massachusetts, New York,

Pennsylvania, Ontario, Michigan, Manitoba, Colorado.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 12.

EXSICCATI: Jaap, Myxom. Exs. 163.

The oval spores with a rather inconspicuous ridge, the rather small size and the association with stable litter are the marks of this species. It is apparently rare but occurs in abundance when found. Jahn (1915) regarded it as primarily coprophilous. Hagelstein (1944) said the spores are shining in mass. That is not apparent in our material.

Badhamia panicea (Fries) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27–28: 71. 1873.

Physarum paniceum Fries, Syst. Myc. 3: 141. 1829.

Reticularia schmitzii Debey, Verh. Nat. Ver. Preuss. Rheinl. 4: 2. 1847.

PBadhamia goniospora Meylan, Bull. Soc. Vaud. Sci. Nat. 56: 66. 1925.

Sporangia gregarious or crowded, subglobose, pulvinate, 0.4–2 mm in diameter, or somewhat plasmodiocarpous, sessile, rarely stalked, white or cinereous; peridium thin, membranous, usually with dense lime deposits, sometimes nearly limeless and iridescent; stalk, when present, short, red; hypothallus thin, inconspicuous, dark red; capillitium dense, white, sometimes aggregated at the base and the center to form a pseudocolumella, usually with some limeless tubules and often with many; spores free, black in mass, bright violaceous brown by transmitted light, sometimes darker on one side and paler on the other, minutely punctate, 11– $14~\mu$ in diameter. Plasmodium white.

TYPE LOCALITY: Lund, Sweden.

HABITAT: Bark and dead wood.

DISTRIBUTION: Europe; southern Canada; the United States; South America; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 10; Hattori, Myxom. Nasu pl. 5, f. 5.

EXSICCATI: Jaap, Myxom. Exs. 63, 121; Brândză, Myxom. Roum. II. 1: 2; III. 1: 1; 91(NY); 64(IA).

In some collections, the capillitium is markedly physaroid. The species is one of several border-line forms.

The var. heterospora G. Lister, Mycet. ed. 3. 17. 1925, based on slight spore difference, does not seem to transcend expected specific range.

Badhamia goniospora, described as differing from B. panicea in its reddish hypothallus and its large, more strongly marked and irregularly shaped spores, 12–16 μ in diameter, may be an imperfectly developed phase of this species.

Badhamia papaveracea Berk. & Rav., in Berk., Grevillea 2: 66. 1873.

Badhamia hyalina var. papaveracea (Berk. & Rav.) A. Lister, Mycet. 30. 1894.

Sporangia closely gregarious, globose or ovate, stalked or sometimes sessile, 0.5–1 mm in diameter, iridescent, gray, white when empty: peridium thin, translucent, smooth or slightly rugulose, weakly calcareous, the lime often forming a surface reticulation; stalk, when present, usually rather short, occasionally exceeding the sporangium in height, cylindric, black or dark brown; hypothallus thin, colorless, common to a cluster, often scarcely apparent; capillitium a white, persistent network of slender tubes, the meshes large; spores adherent in compact clusters of 6–20 or more, pyriform, strongly warted on the exposed surface, elsewhere less prominently warted or smooth, 10–13 μ in diameter. Plasmodium orange.

TYPE LOCALITY: Aiken, South Carolina.

HABITAT: Dead bark.

DISTRIBUTION: Maine to Kansas and South Carolina; Rumania; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 3, d, e; Nat. Geogr. Mag. 49(4): pl. 3.

EXSICCATI: Ellis, N. Am. Fungi 1214 (as B. hyalina); Brândză, Myxom. Roum. 65(IA).

FIG. 213 Plate XXIII

FIG. 214
Plate XXIII

This is a difficult species to define. The original description said there were about seven spores in a group; G. Lister (Mycet. ed. 2 and ed. 3) said the spores were in groups of 6–10 and this is repeated by Hagelstein (1944). Martin (1944) said 6–20. Our best specimen is Brândză's No. 65, which is illustrated. In this, the spores are very firmly united and many of the clusters must contain 25 or more; it is difficult to find a cluster with as few as six. The firm dark stalk is usually erect, but even when prostrate on the substratum, it is usually clearly apparent.

Badhamia calvescens Macbr., Mycologia 18: 129. 1926, from New Zealand, is said to be close to B. papaveracea, and as described could well be included in that species. The type specimen should be in the Iowa collection, but has not been found.

found.

The species is evidently rare and some of the collections referred to it clearly belong elsewhere.

Badhamia populina A. & G. Lister, Jour. Bot. 42: 129. 1904.

FIG. 215 Plate XXIII Sporangia subglobose or ovoid, white or rarely pale rose, 1.2–1.5 mm in diameter, usually sessile and heaped, sometimes forming a pseudoaethalium, less commonly gregarious and borne on short, yellowish, membranous stalks; peridium calcareous, smooth or bearing a concolorous limy net; capillitium coarse, white, somewhat thickened at the nodes and usually with a few hyaline threads; spores clustered firmly or frequently rather loosely, irregularly spherical, strongly warted on the exposed end, elsewhere minutely warted to nearly smooth; $10{\text -}13~\mu$ in diameter. Plasmodium white or cream-colored.

TYPE LOCALITY: England.

HABITAT: Dead wood.

DISTRIBUTION: Europe; Plowa, Colorado, Montana, Washington, Oregon, California.

ILLUSTRATIONS: Jour. Bot. 42: pl. 459, f. 1; Lister, Mycet. ed. 3. pl. 2. EXSICCATI: Cavara, Fungi Longob. 1; Brândză, Myxom. Roum. 115(NY).

The spores are less firmly united than in *B. capsulifera*, the individual sporangia are larger, and tend to be united in large clusters with the peridial walls firmly attached to each other. Such fruitings suggest to the naked eye fruitings of *Mucilago*, but the resemblance, while striking, is superficial.

Our material is scanty and unsatisfactory. The specimen supposedly from Iowa looks as though it may have been part of our single California collection put into an Iowa box by mistake, and two of our Colorado collections may be duplicates. Our figure 215 was drawn from a specimen in the Bilgram collection at Philadelphia.

Badhamia utricularis (Bull.) Berk., Trans. Linn. Soc. 21: 153. 1853.

FIG. 216 Plate XXIV Sphaerocarpus utricularis Bull., Hist. Champ. Fr. 128. 1791.

PTrichia coerulea Trent., in Roth, Catalecta Bot. 1: 229. 1797.

Physarum ovoideum Schum., Enum. Pl. Saell. 2: 198. 1803.

Physarum hyalinum var. chalybaeum Alb. & Schw., Consp. Fung. 92. 1805. Trichia utricularis (Bull.) DC., Fl. Fr. 2: 251. 1805.

Trichia rubiformis Purton, Midl. Fl. 3: 291. 1821. Not T. rubiformis Pers. 1794.

Physarum botryoides Fries, Stirp. Fems. 83. 1825.

Physarum utriculare (Bull.) Chev., Fl. Paris 1: 337. 1826.

Physarum botrytes Sommerf., Suppl. Fl. Lapp. 242. 1826.

Diderma papaverinum Wallr., Fl. Crypt. Germ. 2: 375. 1833.

Dictydium magnum Peck, Ann. Rep. N.Y. State Mus. 24: 84. 1872.

Badhamia magna (Peck) Peck, Ann. Rep. N. Y. State Mus. 31: 57. 1879.

Badhamia varia Massee, Mon. 319. 1892, in part.

Sporangia clustered, usually in large colonies, globose, ovoid or obpyriform, 0.5–1 mm in diameter, mounted on thin, strand-like stalks from which they are pendent, rarely sessile, blue-gray, iridescent violet, or cinereous; peridium iridescent, hyaline or white when empty, smooth, rugulose or netted; stalks pallid, yellowish or tawny, weak, branched, often prostrate; hypothallus dull red, inconspicuous; capillitium delicate, uniform, open, white; spores dull blackish brown in mass, loosely aggregated into clusters which readily fall apart, spherical, distinctly warted over entire surface but sometimes more strongly on one side, usually bright violet-brown, sometimes darker, 10–14 μ in diameter. Plasmodium yellow.

TYPE LOCALITY: France.

HABITAT: The bark of fallen trees and the basidiocarps of leathery fungi. DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Bull. Herb. Fr. pl. 417, f. 1; Lister, Mycet. ed. 3. pl. 4, 9. EXSICCATI: Jaap, Myxom. Exs. 41, 81; Thaxter, Rel. Farl. 381, 383.

When this species occurs on the hymenium of tough or leathery fungi it forms extensive colonies, the sporangia, either singly or in groups, depending from the lower surface of the substratum on long, slender stalks. When it grows on the upper surface the stalks may be shorter or prostrate. A. Lister, in the preface to the first edition of the Mycetozoa refers to his early cytological studies on this species and later (p. 31) states that he had cultivated it for more than six years, in the course of which time the four varieties sessilis, splendens, genuina and schimperiana, all Rost., Mon. 143. 1874, appeared in the cultures, apparently from a single strain. The var. nigripes Racib., Rozp. Akad. Umiej. 12: 70. 1884, was, as the name implies, applied to a form with black stalks, suggesting B. papaveracea.

In some collections the spore clusters keep together fairly well at maturity; in others they fall apart quickly. In the former, the spores are somewhat more strongly warted on what was presumably the exposed area, but the difference is not marked.

B. utricularis is apparently rather common in Europe, but less so elsewhere.

Badhamia versicolor A. Lister, Jour. Bot. 39: 81. 1901.

Sporangia sessile on a broad or narrowed base, 0.2–0.5 mm in diameter, scattered or clustered, gray, flesh colored, yellowish gray, or dingy white, rugose; capillitium white or apricot colored; spores ovoid, arranged in spherical or elliptic, frequently hollow, clusters of 10–40, dull purple and minutely warted at the broader end, elsewhere paler and nearly smooth, 10–14 \times 9–11 μ . Plasmodium colorless.

TYPE LOCALITY: Rhynie, Scotland.

HABITAT: On the bark of living and dead trees, often on mosses and lichens. DISTRIBUTION: Great Britain, Germany, Switzerland; Ontario, Iowa, Missouri, Colorado, Texas, California; India; Hawaii.

ILLUSTRATIONS: Jour. Bot. 39: pl. 419, f. 2; Lister, Mycet. ed. 3. pl. 6.

The capillitium may appear white under a binocular, but the apricot color may appear when it is examined under a compound microscope. The spores do appear

FIG. 217 Plate XXIV to be formed in hollow clusters, even when the clusters break apart readily. Hagelstein (1944) says that the spores when swollen, regain "the normal globose shape." This is not in accord with our experience based, it is true, on limited material. It depends upon the orientation of the spores in the mount. If viewed from a vertical axis, they are circular in outline; when seen horizontally, the characteristic ovate shape is apparent.

Badhamia viridescens Meylan, Bull. Soc. Vaud. Sci. Nat. 53: 452. 1921.

FIG. 218 Plate XXIV Sporangia scattered or loosely clustered, subglobose or pyriform, stipitate, pale yellowish or greenish gray, with a poorly defined, cup-like, darker base, 0.4–0.8 mm in diameter, total height 0.8–1.5 mm; peridium spotted and veined with lime granules, thicker and more persistent below; stalk yellowbrown, sulcate, translucent, not exceeding half the total height; capillitium tubular, filled with pale yellow lime granules, without any hyaline connecting threads; spores free, pale brownish violet, very minutely warted, 9–13 μ in diameter. Plasmodium yellow.

TYPE LOCALITY: Jura Mtns., Switzerland.

HABITAT: Lichens and bark on fallen branches.

DISTRIBUTION: Switzerland; Scotland.

ILLUSTRATIONS: Bull. Soc. Vaud. Sci. Nat. 53: 452, f. 1.

Meylan compares it with *Craterium aureum*, from which it differs in sporangial shape, the larger, paler spores and the badhamioid capillitium. Our single collection, from Meylan, is now pale yellow above, but greenish tints in other limy species tend to fade with age.

EXCLUDED AND DOUBTFUL SPECIES

Badhamia capsulifer Cooke, Fungi Brit. 526. 1872.

Chondrioderma? cookei Rost., Mon. App. 17. 1876, was based on this. Cooke, Myxom. Gr. Brit. 17. 1877, cites it as a synonym of Physarum tussilaginis Berk. & Br., but on p. 81 recognizes it under C. cookei as a distinct species. Probably a Didymium, possibly D. squamulosum or D. dubium.

Badhamia carnea Oedem., Nederl. Kruidk. Arch. II. 1: 166. 1871.

Not a myxomycete. A fungus, possibly a Tubercularia, G. Lister, Mycet. ed. 3. 259.

Badhamia citrinella Čel., Arch. Nat. Land. Böhmen 7(5): 77. 1893.

According to A. & G. Lister, Jour. Bot. 40: 211. 1902, this is a form of *P. auriscalpium*. In the light of more recent studies this must be regarded as doubtful.

Badhamia fasciculata (Jungh.) Rost., Mon. App. 2. 1876.

Based on *Physarum fasciculatum* Jungh., Crypt. Java 11. 1838. Cited by G. Lister, Mycet. ed. 3. 52, as possible synonym of *Physarum reniforme* G. Lister. Identity uncertain. Possibly *P. compressum* of the present treatment.

Badhamia fulvescens Cooke, Grevillea 4: 69. 1875.

Not a myxomycete. The 2nd and 3rd editions of the Lister monograph state that according to Cooke it is a perisporiaceous fungus.

Badhamia irregularis Cooke & Ellis, Grevillea 5: 89. 1876.

Not recognizable from description.

Badhamia mandshurica Skvortz., Philipp. Jour. Sci. 45: 86. 1931.

Neither description nor illustrations, pl. 2, f. 6-8, permit recognition, but apparently close to B. affinis.

Badhamia melanospora Speg., Ann. Soc. Ci. Nat. Arg. 10: 150. 1880.

Possibly B. capsulifera. G. Lister, Mycet. ed. 3. 11. 1925.

Badhamia microcarpa Schroet., Fl. Schles. 3(1): 131. 1886.

Perhaps a small-spored form of B. foliicola. G. Lister, Mycet. ed. 3. 13. 1925.

Badhamia penetralis Cooke & Ellis Grevillea 5: 49. 1876. Possibly a form of Comatricha laxa. G. Lister, Mycet. ed. 3. 143. 1925.

Fuligo

Hall., Hist. Stirp. Helv. 3: 110. 1768.

Aethalium Link, Ges. Nat. Freunde Berlin Mag. 3: 24. 1809.

Aethaliopsis Zopf, Pilzth. 149. 1885.

Fructification aethalioid, occasionally subplasmodiocarpous, consisting of interwoven and poorly defined tubes, each with a calcareous wall, rarely forming masses suggesting densely compacted sporangia; outer portion sterile, forming a fragile cortex, this sometimes nearly lacking; basal layer a membranous hypothallus, the intermediate portion containing spores, capillitium, and limy walls, derived from the plasmodial tubes; capillitium of hyaline, tubular threads connecting the lime-knots, often rather scanty; spores dark in mass.

Type species, Mucor septicus L.

Fuligo is very close to Physarum and in some fruitings, particularly of F. septica, F. intermedia, and F. cinerea they approach very closely and sometimes completely to densely massed sporangia.

KEY TO SPECIES

c.

a. Spores small, 6-9 μ in diameter; aethalia often very large. F. septica

a. Spores large, over 10 μ in diameter;
 aethalia usually of small or medium size.

ь

 Aethalia usually slender, often plasmodiocarpous in aspect, or thin and broadly effused.

c

b. Aethalia compact, pulvinate.
 Spores often elliptical; crust white.

d *F. cinerea*

c. Spores spherical; crust greenish gray or yellowish green.

F. muscorum

 d. Cortex thin, fragile, not strongly calcareous, early fugacious; spores nearly smooth, 11-13 \(\mu\) in diameter;

sometimes appearing as densely massed sporangia.

F. intermedia

d. Cortex thick, spongy, calcareous;
 spores dark, rough-tuberculate
 to subreticulate, 15–20 μ in diameter.

F. megaspora

Fuligo cinerea (Schw.) Morgan, Jour. Cinc. Soc. Nat. Hist. 19: 33. 1896.

Enteridium cinereum Schw., Trans. Am. Phil. Soc. II. 4: 261. 1832.

Lachnobolus cinereus Schw., Trans. Am. Phil. Soc. II. 4: 262. 1832.

Badhamia coadnata Rost., Mon. 146. 1874.

Physarum ellipsosporum Rost., Mon. App. 10. 1876.

Aethaliopsis stercoriformis Zopf, Pilzth. 150. 1885.

Fuligo stercoriformis (Zopf) Racib., Hedwigia 26: 111. 1887.

Fuligo ellipsospora (Rost.) A. Lister, Mycet. 67, 1894.

Fructification white, rather thin, broadly effused or subplasmodiocarpous, 0.5–6 cm in extent or forming a network 15 cm or more across; cortex firm, crustose, rather thick; capillitium of large, irregular, white nodules connected

FIG. 219 Plate XXIV by hyaline threads; spores black in mass, bright violet-brown by transmitted light, varying from spherical, (10–)13–14(–15) μ in diameter to elliptic, and minutely to strongly spinulose, 14–16 \times 10–12 μ . Plasmodium on emergence watery, becoming milk-white, then cinereous.

TYPE LOCALITY: Pennsylvania.

HABITAT: On piles of rotting straw and manure or on detritus in woods. DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 75; Macbr. & Martin, Myxom. pl. 1, f. 11.

EXSICCATI: Jaap, Myxom. Exs. 147, 168; Thaxter, Rel. Farl. 413.

Some of the collections with dark, spinulose, elliptical spores vary so markedly from others with paler, less strongly spinulose, predominantly globose spores that they seem to represent distinct species, but the gradation is continuous, and nearly all collections have some elliptical spores. Morgan (Jour. Cinc. Soc. Nat. Hist. 15: 33. 1896) says that Rex examined the types of both *Enteridium cinereum* and *Lachnobolus cinereus* in the Schweinitz herbarium and found them to agree with what had been widely known as *Physarum ellipsosporum* Rost., which was the basis for Lister's name in *Fuligo*.

A distinctive form which probably belongs here is often found in warm regions, either in the field or, more frequently, developing in moist chamber on debris or bark. Known from Florida, Texas, Greece, Honduras and Tahiti, such fructifications rarely exceed 0.5 cm in diameter and the cortex is convoluted or gyrose. In size, color and markings the spores resemble those of *F. cinerea*.

The species is not rare and fruits profusely on old stable litter used on gardens, where the white aethalia, often reticulate in mass because they tend to fruit on the straw in the litter, show up prominently against the background.

Fuligo intermedia Macbr., N. Am. Slime-Moulds, ed. 2. 30. 1922.

Fuligo cinerea var. ecorticata G. Lister, Mycet. ed. 2. 88. 1911.

Aethalia usually small, occurring in groups, 0.5–3 cm in longest dimension, but sometimes much larger, up to 6 cm or more, 1–10 mm thick, covered with a thin, fragile, yellowish gray or brownish cortex which early breaks off into flakes and then disappears, or cortex lacking, when fructification appears like masses of closely packed and fused, white or ochraceous sporangia, borne on a foamy, yellowish hypothallus; capillitium of large angular lime-knots, often connected by limy strands and with a few hyaline connecting threads; spores black or dusty gray in mass, globose or broadly oval, pale yellow-brown by transmitted light, the globose spores (9-)10-12(-13) μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Colorado.

HABITAT: Dead wood or litter, rarely on living plants.

DISTRIBUTION: New York to Washington, south to Florida, Arizona and Northern California; Africa; Pakistan. Reported from Europe but it is not certain that these reports represent the species as known in the United States.

A very curious and greatly misunderstood species. Hagelstein (1944) says: "Cortex absent" and regarded it as the most important character. That is certainly incorrect. A collection by Bethel from Colorado, which must be regarded as the type, and which is here illustrated, consists of one large aethalium about 2 cm in extent and six smaller ones, all under 1 cm in extent. In these the cortex is broken

FIG. 220 Plate XXIV up into flakes which remain on the surface. However, one of Hagelstein's specimens which apparently belongs here, clearly lacked a cortex from the first, another has the tops of the massed sporangium-like units united over much of the surface as a white, limy crust. A third collection is older and has partly disintegrated, but there is a suggestion of cortical remnants in the mass.

Because of the fragments of cortex and the lime walls of the constituent tubes or sporangium-like units, the capillitium is difficult to see in mounts, but it is strongly badhamioid, with only a few hyaline threads.

Dr. Kowalski reports that this is the commonest Fuligo in northern California.

Fuligo megaspora Sturgis, Colo. Coll. Publ. Sci. 12: 443. 1913.

Aethalia pulvinate, 1.5–7 cm in diameter, covered with a thick, spongy, calcareous cortex, white or yellowish below, spore-mass gray from the abundant network of limy, tubular walls; capillitium scanty, of delicate, colorless, anastomosing threads bearing toward the center large, white, branching nodules; spores spherical, dark purplish brown, rough-tuberculate to subreticulate, (14-)15-20(-22) μ in diameter. Plasmodium unknown.

fig. 221 *Plate* XXIV

TYPE LOCALITY: Colorado. HABITAT: Wood and soil.

DISTRIBUTION: Florida, Nebraska, Colorado, Texas, New Mexico; Guatemala; Costa Rica; Europe; Congo; West Pakistan.

ILLUSTRATIONS: Colo. Coll. Publ. Sci. 12: pl. 2, f. 1–3; Lister, Mycet. ed. 3. pl. 202, d-f.

In addition to the very large, strongly marked spores, this species is characterized by the extremely thick, spongy, calcareous cortex. The size of the aethalium as given in the original description is 15–40 cm. As Hagelstein (1944) notes, this is an obvious misprint for 15–40 mm. Sturgis' Pl. 2, f. 1, "Natural size," is about 4 cm wide above, expanding to 7 cm at the base, which includes what appears to be part of a spongy hypothallus. None of our specimens is as large as this.

The species appears to be rather rare in general but a note in Bethel's hand accompanying a specimen from the white sands area of New Mexico reads: "These white aethalioid Myxos. are common on the hot deseret sands and occasionally occur on the trunks of *Juniperus monosperma*, the only vegetation present." A specimen from Pakistan has very dark, rough spores $20-22 \mu$ in diameter.

Fuligo muscorum Alb. & Schw., Consp. Fung. 86. 1805.

Lignydium griseo-flavum Link, Ges. Nat. Freunde Berlin Mag. 3: 24. 1809. Lignidium muscicola Fries, Symb. Gast. 10. 1817.

Reticularia muscorum (Alb. & Schw.) Fries, Syst. Myc. 3: 91. 1829.

Aethalium muscorum (Alb. & Schw.) Schw., Trans. Am. Phil. Soc. II. 4: 261. 1832.

Licea ochracea Peck, Ann. Rep. N. Y. State Mus. 28: 55. 1876.

Fuligo simulans P. Karst., Bidr. Finl. Nat. Folk 31: 108. 1879.

Fuligo ochracea (Peck) Peck, Ann. Rep. N. Y. State Mus. 31: 56. 1879.

Physarum muscorum (Alb. & Schw.) A. Berl., in Sacc. Syll. Fung. 7: 346. 1888.

Aethalia pulvinate, irregular, small, usually 1 cm or less in width, but sometimes much broader, up to 5 cm, seated on a pallid or dull orange hypothallus; cortex very thin, dingy white, gray, ochraceous or greenish, bearing scattered deposits of lime; internal walls poorly developed, forming a pseudo-

FIG. 222 Plate XXIV capillitium; capillitium of pallid, ochraceous, or dull orange fusiform or branching limeknots, connected by rather short, hyaline threads, often sparse, elastic when abundant; spores yellow-brown, irregularly and rather sparsely warted, $(10-)11-13~\mu$ in diameter. Plasmodium yellow or yellow-green.

TYPE LOCALITY: Germany.

HABITAT: Litter and plant debris and on mosses, especially in moist habitats. DISTRIBUTION: Europe; New England to Ontario and Pennsylvania; Ceylon; Japan.

ILLUSTRATIONS: Alb. & Schw., Consp. Fung. pl. 7, f. 1; Lister, Mycet. ed. 3. pl. 77.

EXSICCATI: Jaap. Myxom. Exs. 7.

Rostafinski (1874) included this in *Physarum gyrosum*, which some fruitings resemble, but the spores are larger than in that species and the usual habit is distinctly aethalioid. The species seems to be uncommon.

Lignidium reniforme Fries, Symb. Gast. 10. 1817, also cited by Rostafinski as a synonym of *P. gyrosum*, is cited in the Lister monograph as doubtful under both *P. gyrosum* and *F. muscorum*.

Golovenko, in Frunze, Izdet. Akad. Nauk Kirghiz 1960: 130. 1960 has described a var. tienshanica from Kazakstan. As the description is entirely in Russian, this is a nomen nudum.

Fuligo septica (L.) Wiggers, Prim. Fl. Holsat. 112. 1780.

FIG. 223 Plate XXIV Mucor septicus L. Sp. Pl. ed. 2. 1656. 1763.

Major mucilage Soon El Corn ed 9 9, 409 175

Mucor mucilago Scop., Fl. Carn. ed. 2. 2: 492. 1772.

Mucor ovatus Schaeff., Fung. Bavar. 4: 132. 1774.

Reticularia carnosa Bull., Hist. Champ. Fr. 85. 1791.

Reticularia hortensis Bull., Hist. Champ. Fr. 86. 1791.

Reticularia lutea Bull., Hist. Champ. Fr. 87. 1791.

Reticularia septica (L.) With., Brit. Pl. ed. 2. 3: 470. 1792.

Reticularia ovata (Schaeff.) With., Brit. Pl. ed. 2. 3: 471. 1792.

Fuligo rufa Pers., Neues Mag. Bot. 1: 88. 1794.

Fuligo flava Pers., Neues Mag. Bot. 1: 88. 1794.

Fuligo candida Pers., Obs. Myc. 1: 92. 1796.

Fuligo vaporaria Pers., Obs. Myc. 1: 92. 1796.

Fuligo pallida Pers., Obs. Myc. 2: 36. 1799.

Fuligo violacea Pers., Syn. Fung. 160. 1801.

Fuligo laevis Pers., Syn. Fung. 160. 1801.

Fuligo carnea Schum., Enum. Pl. Saell. 2: 194. 1803.

Fuligo flavescens Schum., Enum. Pl. Saell. 2: 194. 1803.

Reticularia cerea Sow., Engl. Fungi 3: pl. 399, f. 4. 1803.

Aethalium flavum (Pers.) Link, in Nees, Syst. Pilze Schw. 99. 1816.

Fuligo cerebrina Brondeau, Mem. Soc. Linn. Paris 3: 74. 1824.

Reticularia vaporaria (Pers.) Chev., Fl. Paris. 1: 342. 1826.

Fuligo varians Sommerf., Suppl. Fl. Lapp. 239. 1826.

Aethalium violaceum (Pers.) Spreng., Syst. 4(1): 533. 1827.

Aethalium candidum Schlect., in Spreng., Syst. 4(1): 533. 1827.

Aethalium vaporarium (Pers.) Becker, Fl. Frankf. 2(1): 345. 1828.

Reticularia carnea (Schum.) Fries, Syst. Myc. 3: 91. 1829.

Aethalium septicum (L.) Fries, Syst. Myc. 3: 93. 1829.

Fuligo hortensis (Bull.) Duby, Bot. Gall. 863. 1830.

Fuligo carnosa (Bull.) Duby, Bot. Gall. 863. 1830.

Aethalium ferrincola Schw., Trans. Am. Phil. Soc. II. 4: 261. 1832.

Reticularia rufa (Pers.) Schw., Trans. Am. Phil. Soc. II. 4: 262. 1832.

Aethalium rufum (Pers.) Wallr., Fl. Crypt. Germ. 2: 341. 1833.

Licea lindheimeri Berk., Grevillea 2: 68. 1873.

Fuligo tatrica Racib., Hedwigia 24: 169. 1885.

Tubulina lindheimeri (Berk.) Massee, Mon. 42. 1892.

Fuligo ovata (Schaeff.) Macbr., N. A. Slime-Moulds 23. 1899.

Aethalia pulvinate, rarely subplasmodiocarpous, usually large, 2–20 cm in their longer dimension, 1–3 cm thick, white, ochraceous, greenish, pink, dull red, brown, or violet; cortex calcareous, fragile, usually rather thick and separable; capillitium of white, yellow, or reddish fusiform nodes connected by hyaline threads, sometimes scanty; spores spherical, dull black in mass, purplish brown by transmitted light, minutely spinulose, 6–9 μ in diameter. Plasmodium usually yellow, sometimes white or creamy.

TYPE LOCALITY: France.

HABITAT: Rotten wood and litter, living plants, soil.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Schaeff., Fungi Bavar., pl. 192; Bull., Herb. Fr., pl. 380,
f. 1; pl. 424, f. 1, 2; Bolt., Hist. Fung. pl. 134; Grev., Scot. Crypt. Fl. pl. 272; Lister, Mycet. ed. 3. pl. 74; Nat. Geogr. Mag. 49(4), pl. 2; Hattori, Myxom. Nasu pl. 13, f. 3; Jour. Ind. Bot. Soc. 33: 183, f. 1, A-C.

EXSICCATI: Ellis & Ev., N. Am. Fungi 3200; Ellis & Ev., Fungi Columb. 1500; Thaxter, Rel. Farl. 397; Brândză, Myxom. Roum. II. 1: 21, 22, 23 (NY).

One of the commonest and most widely distributed of Myxomycetes. Its extraordinary variability in size, shape and color is reflected in the numerous names which it has received. The cortex may be very thick or sparse or even lacking, in which case the fruitings appear to be densely clustered and anastomosing sporangia on a common hypothallus, but all have the small, minutely warted, rather pale spores and there seems to be no way to separate them into coherent subgroups. The varieties candida, violacea, flava, rufa, all R. E. Fries, Sv. Bot. Tidskr. 6: 744. 1912, were all validly published, but do no more than name the color involved. The varieties cinnamomea and laevis were irregularly and probably invalidly published. Some, at least, of the specimens referred to the var. violacea are in an early stage of attack by the hypocreaceous fungus Nectriopsis violacea (Schmidt ex Fr.) Maire. Unless cultural studies can demonstrate that some of these variations are due to more than response to conditions under which the plasmodium developed and fruited, they should be disregarded.

Morgan, Jour. Cinc. Soc. Nat. Hist. 19: 32. 1896, pointed out that the brief diagnosis of *Mucor septicus* L., 1763, probably referred only to the plasmodial stage. However, Wiggers, in adopting Linnaeus' epithet, notes the rapid change to a dark mass of spores. We have not seen the description of *Mucor mucilago* Scop., cited as a synonym since Rostafinski's time at least. *Mucor ovatus* Schaeff., is surely this. Both antedate 1780, but there seems to be little point in changing the commonly accepted name at this late date.

Skupienski, Bull. Soc. Myc. Fr. 42: 163–168. 1926, argues at length that *F. rufa* should be recognized as a distinct species, citing differences in plasmodia and ecological relationships as well as in morphology. It is quite conceivable that further study, preferably involving comparative cultures, may confirm his opinion.

DOUBTFUL SPECIES

Fuligo licentii Buchet, Bull. Soc. Myc. Fr. 55: 222. 1935.

This species, collected in the mountains of southeastern China, is said to differ from F. septica in its elastic capillitium and in the spores, which are globose to ovate and densely verrucose, $9-11\times 9~\mu$. An elastic capillitium may occur in F. septica, but the spores of F. licentii seem too large and too strongly marked for that species. The type specimen had lost its cortex. Possibly a valid species, but more material is needed.

Mucor butyracea Schaeff., Fungi Bavar. 4: 132. 1774.

Often cited as a synonym of Fuligo septica. This is possible but neither the description nor the illustration, pl. 194, make it more than that.

Erionema

Penzig, Myxom. Buitenz. 36. 1898. Not Erionema Maire 1906 (error for Eriomena).

Plasmodiocarpous, sometimes sessile, but usually pendent on slender stalks, simple or branched, often anastomosing freely and forming a complex 3-dimensional network. Capillitium elastic, of numerous colorless tubules, most of the junctions unexpanded and limeless, but bearing a relatively small number of calcareous nodes.

Type species, Erionema aureum Penzig.

Very close to *Physarum*, in which it might well be included. The plasmodiocarps of *P. bogoriense* have been observed, as noted under that species, suspended from the substratum by slender filaments much as in *Erionema*, but are not known to form a 3-dimensional network. Some fruitings of *Fuligo septica* which have developed in moist chambers and lack a cortex also approach it. The single species is distinctive and the genus may well be maintained pending further study.

A single species.

Erionema aureum Penzig, Myxom. Buitenz. 37. 1898.

Plasmodiocarps sessile or pendent on slender stalks, simple or branched, terete or flattened, yellow or olive specked with yellow, often anastomosing and when fully developed forming a 3-dimensional network; peridial membrane single, pale yellow, bearing scanty to copious deposits of yellow or ochraceous lime granules; stalks, when present, yellow, filiform, merging with the strands of the hypothallus; capillitium elastic, composed of a persistent net-work of colorless tubules, the junctions mostly limeless but bearing a few yellow fusiform calcareous nodes, expanding to several times its original size upon breaking up of peridium; spores black in mass, pale violaceous brown by transmitted light, minutely punctate, 7–8 μ in diameter. Plasmodium colorless to chrome yellow.

TYPE LOCALITY: Buitenzorg, Java.

HABITAT: Dead wood.

DISTRIBUTION: Malaya; Ceylon, Java; Philippines; Japan.

ILLUSTRATIONS: Jour. Bot. 42, pl. 458; Lister, Mycet. ed. 3, pl. 73.

G. Lister (1904) commented on the resemblance of this species to ecorticate forms of *Fuligo septica* and this is repeated in the second and third editions of the Lister monograph. She also repeatedly refers to the fruitings as sporangia, but they are certainly plasmodiocarps. To us, they seem equally close to *Physarum famintzinii*, which also has an elastic, but much more limy capillitium.

FIG. 224 Plate XXIV

The species appears to be restricted to southern and eastern Asia, and is said to be locally common in Malaya.

Craterium

Trent., in Roth, Catalecta Bot. 1: 224. 1797.

Cupularia Link, Handb. 3: 421. 1833.

Iocraterium Jahn, Hedwigia 43: 302. 1904.

Sporangiate, rarely partly plasmodiocarpous; sporangia cyathiform or globose, stalked or rarely sessile; peridium cartilaginous, more or less incrusted with lime, the lower portion tending to persist as a deep cup; dehiscence circumscissile or irregular at the apex or by a preformed lid; capillitium of hyaline, thread-like tubes connecting calcareous nodes, the latter often aggregated in the center to form a pseudocolumella; spores dark in mass, varying from deep rose or purple to black.

Type species, Craterium pedunculatum Trent.

Characterized by the long-persistent basal cup. The species with distinct lids are readily recognizable; those in which the lid is not clearly delimited nearly always have a cap of different texture from the rest of the sporangium wall and it is that which is shed at dehiscence.

The genus is close to Physarum, and some species of Physarum have a persistent, cup-like base, but the genus in general is well characterized and is worthy of maintaining as a convenience, if no more.

KEY TO SPECIES

Dehiscence circumscissile or by fragmentation of upper part of sporangium, which is often different in texture from lower portion, but rarely forming a distinct lid, and wall then mealy or rough.

b

Dehiscence by a clearly defined, preformed lid, often sunken.

d

Sporangia pinkish to deep purple; cup deep, persistent.

C. paraguayense

Sporangia without pinkish or clear purple colors.

Sporangia pale or whitish above, ochraceous to brownish below, rarely entirely brown;

capillitium white or ochraceous; cup deep, persistent.

C. leucocephalum

Sporangia bright yellow or greenish yellow, fading to ochraceous or dingy white; capillitium orange or yellow, fading; cup tending to be shallow, finally breaking into petaloid lobes.

C. aureum

Sporangia gray with a reddish base; walls limy; nodes pinkish; spores sparsely but prominently spiny to subreticulate.

C. rubronodum

Sporangia brown; walls smooth, glossy, sometimes bearing lime granules, spores minutely spiny.

Sporangia ochraceous brown to dark e.

brown or reddish brown; nodes large, white.

C. minutum

e

Sporangia pinkish brown; nodes small, brown.

C. concinnum

Craterium aureum (Schum.) Rost., Mon. 124. 1874.

Trichia aurea Schum., Enum. Pl. Saell. 2: 208. 1803.

Craterium mutabile Fries, Symb. Gast. 3: 19. 1818.

Cupularia mutabilis (Fries) Rab., Deuts. Krypt.-Fl. 1: 271. 1844.

FIG. 225 Plate XXV Sporangia gregarious, globose or ellipsoidal to obovate, golden yellow, rarely yellow-brown, greenish yellow or pallid ochraceous, stipitate, erect, or occasionally sessile, 0.4–0.6 mm in diameter, 0.7–1.5 mm in total height; peridium thin, especially above, where at maturity it breaks up somewhat reticulately, leaving the more persistent lower portion often with an uneven and finally petaloid margin; stalk short, yellow, brownish red or greenish, arising from a small hypothallus; capillitium dense, yellow, fading, the nodes rather small and irregular, often massed in the center as an orange pseudocolumella; spores black in mass, yellowish brown by transmitted light, minutely warted, 8–10 μ in diameter. Plasmodium clear lemon-yellow.

TYPE LOCALITY: Denmark.

HABITAT: Dead leaves.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 67; Hattori, Myxom. Nasu, pl. 8, f. 3.

EXSICCATI: Jaap, Myxom. Exs. 169; Brândză, Myxom. Roum. II. 1: 27 (NY); 42 (IA).

This species is distinguished by its yellow color, small size, orange pseudo-columella and rather shallow cup which is often petaloid at full maturity. The species as found in North America is well illustrated by Lister's plate, but our English and Portuguese collections are more robust and tend to have a globose sporangium, as do some of those from the western United States.

Craterium mutabile is usually cited as published in Syst. Myc. 3: 154. 1829, but the earlier publication is there cited. The description is much fuller in the Systema than in the Symbolae, and definitely applies to C. aureum. Rostafinski, Mon. 361 (index). 1875, wrote of the 1818 publication "C. minutum p. p." Fries evidently thought he was dealing with the same species and if he was mistaken, his use of the same name in 1829 does not constitute publication of a new name.

Craterium aureonucleatum Nann.-Brem., Acta Bot. Neerl. 10: 62. 1961, is said to resemble C. leucocephalum, but both the description and the illustrations suggest close relationship with C. aureum. A specimen collected by Wingate in Pennsylvania and referred with some hesitation to C. aureum by Macbride, agrees very well with Nannenga-Bremekamp's description. It is not typical C. aureum but may well be considered within the range of that species.

Craterium concinnum Rex, Proc. Acad. Phila. 45: 370. 1893.

FIG. 226 Plate XXV Sporangia stalked, gregarious, 0.2–0.5 mm in diameter, 0.5–0.8 mm tall, broadly funnel-shaped or goblet-shaped; peridium simple, cartilaginous, pinkish brown, bearing scattered brown lime granules, darker below; operculum convex, thin, pale brown, membranous, falling off as a whole at dehiscence; stalk about equal to the spore-case in height or a little shorter, reddish brown, limeless; capillitium rather dense, of small, rounded or angular, brownish nodes connected by short, hyaline threads, the nodes larger toward the center and sometimes tending to form a pseudocolumella; spores dark brown in mass, dusky brown by transmitted light, spinulose, 9–10 μ in diameter. Plasmodium milky, then cream colored.

TYPE LOCALITY: Philadelphia, Pennsylvania.

HABITAT: Dead wood and leaves and vegetable litter, especially of chestnut.

DISTRIBUTION: Massachusetts to Virginia and Iowa; Jamaica; Colombia;

Netherlands; Poland; India; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 79; Hattori, Myxom. Nasu pl. 8, f. 4.

EXSICCATI: Ellis, N. Am. Fungi 1400 (type).

Distinguished by its small size, broad calyculus, sharply delimited and pale operculum which contrasts strongly with the darker cup, the brown nodes and the dusky spores. Deeper cups may occur in the same fruitings with the shallow ones, as correctly shown in the Lister illustration, but the latter seem to be predominant.

The species is rare. Like Arcyria globosa, its favorite substratum in the eastern United States seems to have been on decaying burs of the American chestnut, Castanea dentata Borkh. With the extinction of that tree it has become even rarer, but, like A. globosa, it may sometimes occur on other substrata.

Craterium leucocephalum (Pers.) Ditmar, in Sturm, Deuts. Fl. Pilze 1: 21. 1813.

Stemonitis leucocephala Pers., in J. F. Gmel. Syst. Nat., 2: 1467. 1791.

Arcyria leucocephala (Pers.) Hoffm., Deuts. Fl. 2, pl. 6, f. 1. 1795.

Cyathus cinereus Purton, Midl. Fl. 3: 309. 1821.

Cupularia leucocephala (Pers.) Link, Handb. 3: 421. 1833.

Craterium xanthopus Wallr., Fl. Crypt. Germ. 2: 358. 1833.

Craterium deoperculatum Fries, in Weinm., Fl. Ross. 597. 1836.

Cupularia xanthopus (Wallr.) Rab., Deuts. Krypt.-Fl. 1: 271. 1844.

Craterium pruinosum Corda, Ic. Fung. 6: 13. 1854.

Craterium minimum Berk. & Curt., in Berk., Grevillea 2: 67. 1873.

Physarum scyphoides Cooke & Balf., in Massee, Jour. Myc. 5: 186. 1889.

Craterium cylindricum Massee, Mon. 268. 1892.

Craterium fuckelii Massee, Mon. 272. 1892.

Craterium convivale Morgan, Jour. Cinc. Soc. Nat. Hist. 19: 14. 1896.

Sporangia stalked, gregarious, globose or obovate to cylindric, 0.3–0.7 mm in diameter, 1–1.5 mm tall, not rarely sessile and occasionally subplasmodiocarpous; peridium white and fragile above, ochraceous, yellow-brown or reddish brown and cartilaginous below; dehiscence circumscissile, occasionally somewhat irregular but in globose sporangia in all cases leaving the lower portion of the peridium as a deep, goblet-shaped cup; capillitium of large, irregular, white or ochraceous lime-knots connected by slender, hyaline threads, often massed at the center to form a prominent pseudocolumella; stalk about half the total height or shorter, sometimes lacking, cylindric or expanded upward, reddish brown, translucent, arising from a small, disk-like hypothallus; spores black in mass, violaceous brown by transmitted light, minutely spinulose, 8–9 μ in diameter. Plasmodium yellow.

TYPE LOCALITY: Europe.

HABITAT: Dead leaves and twigs, occasionally wood.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 81; Macbr. & Martin, Myxom. pl. 7, f. 133-137; Hattori, Myxom. Nasu pl. 8, f. 1.

EXSICCATI: Ellis, N. Am. Fungi 1400; Ellis & Ev., N. Am. Fungi 2695; Jaap, Myxom. Exs. 26, 43, 44, 87, 186; Brândză, Myxom. Roum. I. 1: 8; II. 1: 24, 25(NY); 39, 40(IA).

This widely distributed and common species is also extremely variable in size, shape and color and four varieties are often recognized: var. inclusum Čelak. f.,

FIG. 227 Plate XXV Arch. Nat. Land. Böhmen 7(5): 79. 1893 for fruitings with clustered sporangia; var. cylindricum (Massee) G. Lister, Mon. ed. 2. 97. 1911, including C. minimum, for cylindrical forms; var. scyphoides (Cooke & Balf.) G. Lister, Mycet. ed. 2. 97. 1911, for globose or turbinate forms with a poorly defined lid; and var. rufum G. Lister, Mycet. ed. 3. 78. 1925, for short-stalked, brownish red collections with clearly defined lids. However, while some collections seem very distinctive, others connect them by every possible gradation. A small collection from Iowa, obviously from a single plasmodium, shows fruitings varying from sporangiate, to clustered sporangia to well-developed plasmodiocarps. There seems little point in maintaining the varietal names.

Nannenga-Bremekamp, in describing *C. aureonucleatum*, mentioned that that species was characterized by yellow crystalline corpuscles in the peridium similar to those in *C. leucocephalum*. We find such bodies abundant in some specimens of the latter species, sparse in others, and completely lacking in many.

Craterium minutum (Leers) Fries, Syst. Myc. 3: 151. 1829.

FIG. 228 Plate XXV Peziza minuta Leers, Fl. Herborn. 277. 1775.

Nidularia minuta (Leers) With., Brit. Pl. ed. 2, 2; 859, 1787.

Cyathus minutus (Leers) Hoffm., Veg. Crypt. 2: 6. 1790.

Trichia minuta (Leers) Relhan, Fl. Cantabr. Suppl. 3: 37. 1793.

Craterium pedunculatum Trent., in Roth, Catalecta Bot. 1: 224. 1797.

Physarum turbinatum Schum., Enum. Pl. Saell. 2: 205. 1803.

Physarum pedunculatum (Trent.) Schum., Enum. Pl. Saell. 2: 206. 1803.

Craterium vulgare Ditmar, in Sturm, Deuts, Fl. Pilze 1: 17. 1813.

Craterium pyriforme Ditmar, in Sturm, Deuts. Fl. Pilze 1: 19. 1813.

Craterium turbinatum (Schum.) Fries, Symb. Gast. 18. 1818.

Craterium nutans Fries, Syst. Myc. 3: 151. 1829.

Craterium oerstedtii Rost., Mon. 120. 1874.

Craterium friesii Rost., Mon. 122. 1874.

Craterium confusum Massee, Mon. 263. 1892.

Sporangia gregarious, usually stalked, sometimes sessile, 0.2–0.8 mm in diameter, 0.3–1.5 mm tall, goblet-shaped, ochraceous brown or olivaceous to deep chocolate, umber, or bright brownish red, usually darker below; peridium thick, double, the outer layer cartilaginous or rarely limy, the inner layer limy and white, varying to membranous and translucent; dehiscence by a distinct operculum which is sharply separated from the peridium, often by a prominent ring, usually depressed at the margin, sometimes throughout, sometimes convex and protruding, paler than the peridium, varying from white to ochraceous, brown, or red; stalk usually slightly paler than the base of the cup, orange-red, translucent, furrowed, half the total height or less, sometimes lacking; hypothallus distinct, discoid; capillitium physaroid, the nodes large, irregular, white or ochraceous, tending to become aggregated at the center; spores black in mass, violaceous brown by transmitted light, minutely warted, 8–10 μ in diameter. Plasmodium white, bright yellow, or orange.

TYPE LOCALITY: Germany.

HABITAT: Dead leaves and twigs, sometimes wood or bark.

DISTRIBUTION: Common in Europe and temperate North America; possibly commoner elsewhere than reports indicate. We have specimens from Liberia, India, the Philippines and New Zealand.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 78; Macbr. & Martin, Myxom. pl. 7, f. 138-140; Hattori, Myxom. Nasu pl. 8, f. 2.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2500; Jaap, Myxom. Exs. 25; Brândză, Myxom. Roum. II, 1: 26; 96(NY); 41(IA).

This species is characterized by the deep, brown cups and the sharply separated, often sunken, lids.

The varieties genuinum and turbinatum, both Rost., Mon. 121. 1874, are separated on the basis of minor differences which mark no more than legitimate variations within a species.

Craterium paraguayense (Speg.) G. Lister, in Lister, Mycet. ed. 2. 95. 1911.

Didymium paraguayense Speg., Anal. Soc. Ci. Argent. 22: 186. 1886.

Craterium rubescens Rex, Proc. Acad. Phila. 45: 370. 1893.

Iocraterium rubescens (Rex) Jahn, Hedwigia 43: 302. 1904.

Iocraterium paraguayense (Speg.) Torrend, Broteria 8: 114. 1908.

Sporangia gregarious, cylindric or elongate-cyathiform, stipitate, 0.3–0.6 mm in diameter, 0.6–0.8 mm tall, bright pinkish lavender through rose-purple to dark reddish violet or deep purplish brown, the apex slightly roughened by pale calcareous granules, the peridium longitudinally wrinkled below; dehiscence irregularly circumscissile; stalk dark, longitudinally wrinkled, about one-half the total height; capillitium dense, violet, strongly calcareous; spores pinkish brown to deep violet-brown in mass, pale violaceous by transmitted light, minutely roughened, 8–9 μ in diameter. Plasmodium dark reddish purple.

TYPE LOCALITY: Paraguay or Argentina.

HABITAT: Dead leaves.

DISTRIBUTION: Plowa, Florida, Louisiana, Texas; Panama; South America.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 80.

EXSICCATI: Langl., Fl. Ludovic. 2327 (as Physarum lilacinum Ellis & Ev., nomen nudum).

This species is readily recognized by its color alone. It seems to be largely subtropical or tropical. The Iowa report is based on two boxes, both labelled Hardin County, Iowa, one in Macbride's hand, the other in Shimek's, and almost certainly parts of the same collection.

The dark plasmodium is common on Barro Colorado Island in the Panama Canal Zone, on rotting palm leaves, but good fruiting specimens are difficult to find, perhaps because they are washed away by the torrential rains. Most of the collections from that area are bright lilac, but some show complete gradation to the deep purple specimens from Louisiana.

Jahn based his genus *Iocraterium* on what he interpreted as a true columella as contrasted with the pseudocolumella often found in other species of *Craterium*. This character is very variable in all species and probably should not be recognized as warranting generic segregation.

Didymium guarapiense Speg., Anal. Soc. Ci. Argent. 26: 60. 1890, is certainly this species. It may have been an error, as stated in all three editions of the Lister monograph, but it seems more probable that it was a deliberate correction, to indicate that the type was collected in Argentina rather than in Paraguay. If that is the case, it was validly published, but is a later synonym of the original name. Craterium paraguariense (Speg.) Sacc. & Trotter, in Sacc., Syll. Fung. 22: 798. 1913, was probably intended as a legitimate philological correction, but its necessity is not apparent.

Craterium rubronodum G. Lister, Trans. Brit. Myc. Soc. 5: 74. 1915.

Sporangia stalked, gregarious, goblet- or saucer-shaped, 0.2-0.4 mm tall,

FIG. 229

Plate XXV

0.2–0.6 mm wide, smooth, pearl-gray with a dark red-brown base; lid well-defined, convex or nearly flat, white or pinkish, smooth, with an upturned rim; peridium somewhat cartilaginous, pinkish gray, with uniform lime deposits on the outside, studded within with discrete limy tubercles; the stalk dark red-brown, slender, 0.1–0.2 mm high, arising from a discoid hypothallus; capillitium of ovoid or irregularly rounded pale pink nodes connected by hyaline tubules, usually with a large central hollow or solid pseudocolumella; spores black in mass, purplish gray by transmitted light, marked with scattered spines or ridges often forming an incomplete reticulation, 10–12 μ in diameter. Plasmodium primrose yellow, becoming orange.

TYPE LOCALITY: Tanabe, Kii, Japan. HABITAT: Dead leaves and litter. DISTRIBUTION: Japan; India.

ILLUSTRATIONS: Trans. Brit. Myc. Soc. 74, pl. 1, f. 1, a-d; Lister, Mycet. ed. 3. pl. 205.

The pinkish nodes and characteristic spores mark this species clearly. We have seen no specimens, hence the preceding description is based on the published accounts.

EXCLUDED OR DOUBTFUL SPECIES

Craterium leucocephalum Desm., Cat. Pl. Belg. 27. 1823. n. v.

Cited by Rost., Mon. 119. 1874, as synonym of *C. vulgare* Ditm.; by Berlese, in Sacc., Syll. 7: 355, of *C. pedunculatum*. It is doubtful whether Desmazières' binomial was published as new.

"Craterium leucocephalum Grev.", Scot. Crypt. Fl., pl. 65. 1823.

Cited by Rost., Mon. 121. 1874, as synonym of C. minutum. Greville's figure may represent that species, but he published it as C. leucocephalum Ditmar.

Craterium leucostictum (Chev.) Fries, Syst. Myc. 3: 152. 1829.

Based on *Physarum leucostictum* Chev., Fl. Par. 1: 336. 1826. Both are cited by Rost., Mon. 123. 1874, as synonyms of *C. leucocephalum*, with "p. p." added to both in the index.

"Craterium minutum Cooke", Brit. Fungi, no. 525. 1872.

Cited as synonym of *C. pedunculatum* by Berlese, in Sacc., Syll. Fung. 7: 355. While the original has not been seen, the citations in Cooke, Myxom. Gt. Brit. 19. 1877, make it clear that this was not intended as a new combination.

"Craterium minutum Fuckel", Jahrb. Nass. Ver. Nat. 23-24: 342. 1870.

Cited by Berlese, in Sacc. Syll. 7: 356, as synonym of C. nitens Fries "Excl. syn.!" Fuckel referred his material to C. minutum Fries.

Craterium pendulum Fries, in Weinm., Fl. Ross. 597. 1836.

Cited by Rostafinski, Mon. 123. 1874, as a synonym of C. leucocephalum; "p. p." in index.

Craterium vulgare Chev., Fl. Par. 1: 340. 1826. n.v.

May not have been published as new; if not, citation should be to Ditmar.

Physarum

Pers., Neues Mag. Bot. 1: 88. 1794.

Angioridium Grev., Scot. Crypt. Fl. pl. 210. 1827.

Trichamphora Jungh., Crypt. Java 12. 1838.

Claustria Fries, Summa Veg. Scand. 451. 1849.

Tilmadoche Fries, Summa Veg. Scand. 454. 1849.

Crateriachea Rost., Versuch 11. 1873.

Cytidium Morgan, Jour. Cinc. Soc. Nat. Hist. 19. 8. 1896.

Sporangiate to plasmodiocarpous, rarely almost aethalioid; peridium single or double, calcareous; stalk, when present, usually tubular and translucent, or stuffed with lime or dark amorphous material, sometimes with lime on exterior surface only; capillitium a network of hyaline tubules connecting calcareous nodes, attached to the base and to the peridium; lime in the peridium, capillitium and stalk in the form of amorphous granules, rarely subcrystalline; spores black or dark brown in mass, violet-brown or violaceous by transmitted light.

Type species, Physarum aureum Pers.

In occasional collections of various species, the lime may be deposited on the peridium in the form of crystalline plates, resembling those of *Lepidoderma*. In at least some instances it seems probable that this appearance is the result of wetting and drying.

Physarum is the largest genus of the Myxomycetes and, as might be expected, its various species show a wide range of characters. Some fruitings of Physarum gyrosum approach Fuligo and have been referred to that genus. At the Paris Congress in 1954, Locquin suggested that Fuligo and Physarum be united. This would involve new combinations for nearly all the species of Physarum, since Fuligo is the older name, and such a step would be unfortunate unless it appeared to be absolutely necessary, which, in our opinion, has not been completely demonstrated. Attempts have been made to divide the genus, as is shown by the synonymy cited above, but in no case can such division be made except on an arbitrary and artificial basis. There is also a very close approach to Badhamia and Craterium. It may well be that transfer of additional species of Badhamia to Physarum would make both genera more natural and the former, at least, more homogeneous. Craterium is, on the whole, more distinctive, and, while it does merge into several species of Physarum, it offers no great difficulty. It may well be maintained for the present.

KEYS TO SPECIES

In the following keys, the species are divided for convenience into seven groups. These are without taxonomic significance. Each species is placed where its commonest and presumably most characteristic expression seems to indicate is appropriate, but since many are extremely variable, it has seemed desirable to include some in more than one key or more than once in the same key. It must be emphasized that many species not so keyed, and which are ordinarily sporangiate and stalked, may be sessile or even plasmodiocarpous at times; that color may vary greatly and that some colors, particularly greens and yellows, tend to fade with time in storage in collections, or with exposure in the field, becoming dingy white. Only experience can give facility in judging such fruitings. The keys cannot take all such variations into account; they can do no more than direct the user's attention to descriptions which should be considered.

- a. Primarily sessile; sporangiate to plasmodiocarpous or pseudoaethalioid, sometimes with a constricted base or attached to a weak, stalk-like extension of the hypothallus, rarely with true stalks.
- a. Primarily stalked and sporangiate; sessile or plasmodiocarpous fruitings often occur, but are usually accompanied by stalked sporangia.
 - Peridium single, or, if double, the inner layer firmly attached to the outer limy crust; lime sometimes in scales or patches, then readily flaking away. Key I, p. 276
 - b. Peridium double, rarely triple, the inner layer distant from the outer layer or layers, or, if appressed, readily separating; lime usually deposited as a persistent crust.
- separating; lime usually deposited as a persistent crust. Key II, p. 277 c. Columella present. Key III, p. 279
- c. Columella lacking; pseudocolumella sometimes present.

b

c

	d.	Nodes massed in center to form a calcareous central body or pseudocolumella.	Key IV, p. 280
	d.	Calcareous central body or pseudocolumella usually lacking, rarely present.	e
e.		rangia strongly compressed	
		rally, annulate, saucer-shaped or lobed.	Key V, p. 280
e.	Spo	rangia globose to oval or lenticular.	f
	f.	Capillitium reticulate, not notably dichotomously branched and radiating from base of peridium; nodes angular or rounded, rarely fusiform.	Key VI, p. 281
	f.	Capillitium dichotomously branched, usually with many cross-connections, radiating	V VII 000
		from base of peridium; nodes mostly fusiform.	Key VII, p. 282
KEY	ı		
a.		dominantly sporangiate, but often forming,	
		ll, rarely branched or netted, plasmodiocarps.	ь
a.	Pre	dominantly plasmodiocarpous, often forming a	
	net;	often broken into small plasmodiocarps or sporangia.	p
	b.	Capillitium strongly elastic,	
		expanding when wall is broken.	P. famintzinii
	b.	Capillitium not notably elastic.	c
c.		res tending to be elliptical	~ .
		outline, encircled by a pale band.	P. ovisporum
c.	Spo	res globose or nearly so, not encircled by a pale band.	d
	d.	White or ashy gray, without ochraceous tints. Some species keyed under following may at times be white.	e
	d.	Usually distinctly colored or dark, sometimes ochraceous or dingy yellowish white.	g
e.		orangiate on a constricted base; peridium thin, nearly aslucent, except for a white, limy reticulum on surface.	P. gilkeyanum
_		- · · · · · · · · · · · · · · · · · · ·	
e.	_	orangiate on a broad base; peridium not bearing a limy r	iet. i
	f.	Capillitium scanty, nearly limeless; peridium thin, delicate, with at most a scanty deposit of lime; plasmodiocarps rare, simple; plasmodium yellow. See	P. nudum
	f.	Capillitium abundant, limy; peridium fragile but	
		bearing abundant lime flakes; plasmodium white, or sometimes yellow before fruiting; spores pale.	P. cinereum
	f.	Capillitium abundant, limy; peridium	
		thick, calcareous; plasmodiocarps often well-developed; plasmodia white; spores dark.	P. vernum
g.	Spo	orangia in dense, heaped clusters.	h
g.		orangia scattered or crowded, but not heaped.	i
_	h.	Green or yellow, sometimes	
		ochraceous or pallid; sometimes on weak stalks.	P. virescens
	h.	Dull, dark violaceous brown, varying to pallid or white; never stalked.	P. confertum
i.		rangia crowded, cylindric or irregular, en bluntly lobed, clay-colored to snuff brown.	P. digitatum
i.	Spo	rangia scattered or gregarious, rarely wded, not clay-colored nor snuff brown.	j
	j.	Peridium nearly limeless, membranous,	•
	•	gray, iridescent; sessile on a constricted base or sometimes with weak stalks.	P. nudum
		The second secon	

	j. Peridium usually notably limy.	k
k.	Predominantly yellow.	1
k.	Predominantly red, brown or green.	m
	l. Bright chrome yellow; when lime	
	is continuous, wall may appear double.	P. luteolum
	 Yellow-brown, often with white, yellow or reddish scales or patches; lime rarely con 	tinuous. P. decipiens
m.	Nodes rounded, yellow, with red centers;	
	sporangia red, scarlet or orange, sometimes fadin	ng. P. lateritium
m.	Nodes angular, rarely with red centers.	n
	 Sporangia small, mostly 0.3–0.5 mm in diameter; peridium reddish brown or brown pale spots; nodes small, deep ochraceous or 	
	n. Sporangia larger, mostly 0.5-1.2 mm in diameter; nodes large, angular.	o
о.	Scarlet, red-brown or olive-brown; peridium	_
0.	thin, rugulose; nodes sometimes reddish internal	ly. P. rubiginosum
o.	Reddish to orange or green, often fading to	
	ochraceous or dingy white; peridium	
	smooth but often with embedded scales.	P. auriscalpium
	p. Capillitium elastic, duplex, of large white	h
	spikes borne on peridium and small yellowis fusiform nodes on a dichotomous net;	
	fructification of rosette-like plasmodiocarps	
	often fusing into a pseudoaethalium,	
	varying to separate, sessile or stalked spora	ngia. P. gyrosum
	or district the second second	
~		q P. samula
\mathbf{q} .	Dull yellow to ochraceous.	P. serpula
$\mathbf{q}.$	White or grayish white.	_ r
	r. Spores pale violaceous, $6-8 \mu$.	P. sessile
	r. Spores darker, larger.	s
s.	Spores medium brown, warted, (9–)10–12 μ;	D
	peridium limy, rugose; plasmodiocarps flattened	P. vernum
s.	Spores dark, distinctly warted, 10–12.5 μ ;	11 5
	plasmodiocarps terete or slightly compressed lat	erally. P. compressum
KEY	у п	
a.	Primarily sporangiate, often passing into	
	pulvinate, rarely long, usually unbranched plasn	nodiocarps. b
a.	Primarily plasmodiocarpous, often long,	-
	branched and reticulate, frequently	
	accompanied by short plasmodiocarps or sporar	gia. 1
	b. Fructifications white; peridial layers distan	t. c
	b. Fructifications white to ochraceous or	
	darker; peridial layers close or in contact.	f
c.	Sporangia globose or ovate, gregarious or densel but not notably depressed; pseudocolumella of	y clustered ten present. d
c.	Sporangia notably depressed, closely	•
	united; pseudocolumella usually lacking.	е
	 d. Sporangia cylindric or ovoid, 0.4–0.6 mm ir diameter, densely aggregated; spores spiny 	
	d. Sporangia globose, up to 1 mm in	
	diameter, clustered, sessile on a	
	constricted base; spores minutely spinulose	, 10–12 μ. P. diderma

e.	Sporangia covered by a continuous tesselate limy crust; spores dark, warted.	P. tessellatum
e.	Sporangia not covered by a tessellate	
	crust; spores very dark, conspicuously spinulose.	P. spinulosum
	f. Sporangia pulvinate, densely	•
	massed, sometimes pseudoaethalioid.	g
	f. Sporangia subglobose or pulvinate,	
	gregarious or clustered but rarely pseudoaethalioid.	h
g.	Sporangia plane or sunken above;	
	spores dark, strongly marked, 11–13 μ .	P. contextum
\mathbf{g} .	Sporangia rounded above;	n 1
	spores pale, nearly smooth, 8–10 μ.	P. conglomeratum
	h. Outer peridium mucilaginous when moist.	P. mucosum
	h. Outer peridium not mucilaginous when moist.	1
i.	Nodes white.	P. mortoni
i.	Nodes yellow or red, sometimes fading to dingy.	j
	j. Capillitium dense, somewhat elastic,	
	many of the threads flattened as in Leocarpus; sessile or borne on	
	weak, stalk-like extensions of the hypothallus.	P. albescens
	j. Capillitium typically physaroid, not elastic.	k
k.	Dull yellow to ochraceous brown; nodes yellow; sessile.	P. alpinum
k.	Pinkish brown or dusky; nodes	- · · · · · · · · · · · · · · · · · · ·
	pink to scarlet; sessile or on weak stalks.	P. rubronodum
	l. Strongly compressed laterally.	m
	l. Terete, or only slightly compressed laterally.	p
m.	Capillitium elastic, duplex, of long spikes arising	*
	from peridium and small fusiform nodes on a	
	dichotomously branched net; often massed	
	in rosettes or pseudoaethalia; peridium appearing	D
	double when lime is abundant; dehiscence irregular.	P. gyrosum
m.	Capillitium neither elastic nor duplex; not forming	
	pseudoaethalia; dehiscence by a preformed apical fissure.	n
	 spores minutely spinulose, pale, 8–10 μ; plasmodiocarps white to drab or yellow. 	P. bivalve
	n. Spores strongly sculptured, dark,	1. Steatee
	mostly larger, more or less reticulate.	o
0.	Peridium white, chalky; spores	
	incompletely reticulate and spiny, $11-13 \mu$.	P. echinosporum
о.	Peridium brown, glossy, fragile;	·
	spores strongly reticulate, 9-11 μ.	P. retisporum
	p. Plasmodiocarps white or pallid.	q
	p. Plasmodiocarps distinctly colored.	S
$\mathbf{q}.$	Spores strongly reticulate.	P. dictyosporum
q.	Spores not reticulate.	1
	r. Terete or slightly compressed; nodes not	
	angular; spores coarsely spinulose, 10-13 μ.	P. bitectum
	r. Terete; nodes angular; spores smooth, 7-8 μ .	P. laevisporum
s.	Scarlet, nodes pale yellow with deep orange-red centers.	P. nasuense
s.	Peridium not uniformly scarlet; nodes not with darker ce	
	t. Outer peridium cartilaginous, bronze,	· · · · · · · · · · · · · · · · · · ·
	wrinkled, with little or no lime; nodes brown.	P. aeneum
	t Outer peridium lime, podes not brown	•

u.	mar. brig	er peridium variegated, deep reddish orange, but ked by paler lines and patches; nodes at first ht orange, tending to fade; spores dark, ted, sometimes in a reticulate pattern, 10–12 μ.	P. variegatum
u.	Out	er peridium not variegated; nodes pallid or te; spores pale, minutely warted or punctate, under 10	μ. ν
	v.	Outer peridium smooth, dull yellow to brown, white inside, dehiscing by triangular lobes exposing the delicate, evanescent inner layer covering the spore-mass; nodes white.	P. bogoriense
	v.	Outer peridium rough, yellow to orange; dehiscence apical, but not by a	Ü
		pre-formed fissure; nodes yellow to pallid.	P. superbum
KEY	111		
a.	Colu	umella large, conspicuous.	b
a.	Col	umella small, usually a short, conical projection of the	stalk. f
	b.	Spores reticulate; columella black, clavate or conical, rarely reduced	
		or lacking; nodes fusiform, yellow.	P. dictyospermum
	b.	Spores not reticulate.	c
c.	Col	umella reaching almost or quite to top of sporangial ca	vity. d
c.	Col	umella rarely exceeding center of sporangial cavity.	e
	d.	Columella calcareous, dull, often dark, with large angular nodes clustered about it, often short or lacking.	P. crateriforme
	d.	Columella not calcareous, slender, cylindrical, orange-brown to pallid; usually % or more of	2 / 0/4/0/4/0/4/0
		sporangial cavity; sporangia olivaceous, usually prola	te. P. penetrale
e.		umella subglobose or broadly clavate; illitium dichotomous, with yellow, fusiform nodes.	P. listeri
e.	Col	umella bluntly conical; capillitium culate, with pale yellow rounded nodes.	P. perfectum
	f.	Sporangia yellow or orange.	
	f.	Sporangia neither yellow nor orange.	g
g.		des white; peridium	
	hon	ley-yellow; stalk white, yellow, or tawny. des yellow or red.	P. melleum h
g.		Sporangia bright yellow; columella and stalk yellow.	P. citrinum
	h. h	,	
i.		Sporangia orange to bronze-tawny; stalk orange-red. rangia white or pallid.	P. pulcherripes
i.		rangia distinctly colored.	j k
••	j.	Sporangia white, rarely pale ochraceous	•
	J.	or pinkish; capillitium dense, with numerous small rounded nodes; columella sometimes lacking.	P. globuliferum
	j.	Sporangia white; capillitium open, with large angular nodes; columella, when	n 1
k.	Dt	present, very short, broadly conical, often lacking.	P. leucopus
к. k.		ght lilac or blue throughout.	P. bilgramii 1
٨.	1.	t bright lilac or blue.	-
	1. 1.	Sporangia and stalks deep maroon; nodes purple. Sporangia, stalks and nodes brown.	P. pulcherrimum
m.		lk limeless; columella often lacking.	m P. mennagae
m.		lk limy; columella usually present.	P. murinum

KEY	IV	
a.	Lime mass subspherical, in center of	ь
a.	sporangial cavity, free from base; sporangia globose. Lime mass irregular, often attached	Б
۵.	to base and forming a pseudocolumella.	c
	b. Capillitium delicate; stalk calcareous; spores 8–10 μ .	P. stellatum
	b. Capillitium dense; stalk not	Dalamt
_	calcareous; spores 6.6–7.5 μ .	P. nucleatum
c.	Sporangia obconic, multilobed or distorted.	P. nicaraguense
c.	Sporangia globose to cylindrical, or plasmodiocarpous, but not notably lobed or distorted.	d
	 d. Sporangiate to plasmodiocarpous; lime in central mass sometimes crystalline; spores spinulose, 8–10 μ. 	P. mutabile
	d. Typically sporangiate; lime in	
	center not crystalline; spores spiny, larger.	e
e.	Sporangia up to 1 mm in diameter, often clustered but rarely forming a pseudoaethalium; spores mostly 10–12 μ .	P. diderma
e.	Sporangia 0.4–0.6 mm in diameter; densely massed, often pseudoaethalioid; spores mostly 12–15 μ .	P. didermoides
T	here are other species in which the lime is sometimes mas	sed in the center,
	only in those keyed above does it seem to be common enougharacteristic.	gh to be regarded
KEY		1
a.	Fructifications flattened laterally.	b
a.	Fructifications not flattened laterally.	f
	b. Primarily sporangiate.	c d
_	b. Primarily plasmodiocarpous.	α
c.	Fructifications ovoid to reniform or flabellate, stalked or sessile, varying to plasmodiocarpous;	
	stalks when present, stout, opaque or frosted with lime.	P. compressum
c.	Usually sporangiate and stalked; sporangia obovoid or cuneate; stalks weak, pallid, translucent, often branched.	P. straminipes
	d. Plasmodiocarps intricate, aggregated into rosettes or	·
	pseudoaethalia; dehiscence irregular; capillitium elast	ic. P. gyrosum
	d. Plasmodiocarps rarely densely aggregated; dehiscence	
	by a preformed apical fissure; capillitium not elastic	
e.	Spores strongly reticulate, by ridges.	P. retisporum
e.	Spores strongly spinose, the spines sometimes forming a broken reticulate pattern, $10-12 \mu$.	P. echinosporum
e.	Spores minutely spinulose, 8–10 μ .	P. bivalve
	f. Sporangia depressed above, patellate, cupulate or ann	ulate. g
	f. Sporangia convex above, lobate or distorted, often appearing compound.	j
g.	Discoid, umbilicate above, often annular;	,
ο.	stalk, when present, short, dark; spores dark.	h
g.	Cupulate or patellate; stalk slender; spores pale.	i
	h. Capillitium distinctly physaroid.	P. megalosporum
	h. Capillitium approaching	D = 11
	badhamioid. Some orbiculate forms of	Badhamia affinis
i.	Sporangia saucer-shaped, on long, slender, reddish brown translucent stalks;	
	peridium delicate, membranous, persistent.	P. pezizoideum

	j.	Capillitium of large, angular, white nodes, massed in center, sometimes forming a pseudocolumella; stalk short, stout.	P. nicaraguense
	j.	Capillitium delicate, the nodes small, fusiform, on	P. polycephalum
KEY a.		ks, when present, weak, flaccid,	
a.		obvious extensions of hypothallus.	ь
a.	Stal	ks, when present, morphologically distinct from hypotha	llus. c
	b.	Sporangia ovoid to cylindrical, densely massed; outer peridium white, calcareous, tending to break away, exposing plumbeus inner peridium; capillitium physaroid.	P. didermoides
	b.	Sporangia subglobose to obovoid, clustered but not massed; outer peridium white to pale yellow or fulvous, closely attached to membranous inner peridium; capillitium tending to be flattened with many limeless junctions.	P. albescens
c.	Spo	orangia white or ashy gray; nodes white.	d
c.		orangia not white, rarely pale gray and nodes then usuall	y yellow. h
	d.	Stalks white or pallid, fragile, calcareous throughout.	е
	d.	Stalks dark or externally frosted with lime, but not calcareous within, varying to pale, translucent.	f
e.		oillitium dense, the nodes Ill, rounded, columella usually present.	P. globuliferum
e.	Cap	pillitium open, the nodes angular, mella rarely present; with aspect of <i>Didymium</i> .	P. leucopus
	f.	Sporangia small, 0.4–0.6 mm in diameter, white, often with a persistent brownish base; stalks usually long, slender, cylindrical, brown, sometimes subulate and shorter.	P. pusillum
	f.	Sporangia usually larger; stalks short, stout, dark or frosted.	
g.	Der	pressed-globose, very calcareous, often clustered on stalks	g P. notabile
g.	Glo dar	bose to subdepressed or ovate, with ker base; peridium not notably calcareous, netimes nearly limeless and then somewhat iridescent.	P. leucophaeum
	h.	Sporangia markedly iridescent.	i
i.		Sporangia not iridescent or at most slightly so. rangia iridescent blue or bronze with crystalline orange deposits; stalk bright orange or yellow	j P. psittacinum
i.	Spo ligh	rangia dark gray, the upper part iridescent, atly sprinkled with white lime flakes, sharply arated from dark, cup-like base; stalk black.	P. tropicale
	j.	Sporangia rose-purple or purplish red throughout.	k
	j.	Sporangia yellow, orange, flesh-colored or brown, or, if pallid, with yellow nodes.	1
k.		rlet; stalks rather long, nder, translucent; spores pale under lens.	P. roseum

Sporangia obconic or turbinate; stalk white above, dark and opaque below;

peridium dehiscent above, often persistent below.

P. javanicum

k.	Rose-purple; stalks thick, opaque; sporangia sometimes sessile; spores dark under lens.	P. newtonii
	l. Peridium smooth, crustose, varnished, yellow-brown.	P. brunneolum
	l. Peridium neither crustose nor varnished.	m
m.	Peridium dull yellow or ochraceous to olivaceous or dusky, rarely green; sometimes fading to dingy white.	n
m.	Peridium bright yellow or orange	
	or, if dingy white, nodes usually yellow.	s
	n. Stalk and base of peridium	
	flesh-colored, fading to ochraceous above.	P. carneum
	n. Stalk and base of peridium not flesh-colored.	0
о.	Peridium scaly, dull yellow to	
	orange-brown, rarely green; stalks	P. aurica alaium
	very short; mainly sessile or plasmodiocarpous.	P. auriscalpium
о.	Peridium not conspicuously scaly; stalks usually well-developed; rarely sessile or plasmodiocarpous.	n
	p. Stalks calcareous, opaque, white or	P
	dull brown; peridium double, the outer	
	layer brown, smooth, the inner layer membranous.	P. flavidum
	p. Stalks translucent, not calcareous; peridium single.	q
q.	Stalks long, slender, usually 3 times	
-	diameter of sporangium or more, rarely less;	
	peridium yellowish, with little lime, or	D 6
	membranous, appearing sooty; nodes often fusiform.	P. flavicomum
q.	Stalks shorter and stouter, rarely more than	. .
	twice the diameter of the sporangium; nodes rarely fusifor	n. r
	 Sporangium dull brown, sooty; stalk sometimes prolonged as a columella. 	P. mennagae
	r. Sporangia dingy yellow to ochraceous,	- · · · · · · · · · · · · · · · · · · ·
	yellow-brown or olivaceous; never columellate.	P. sulphureum
s.	Stalks calcareous; sporangia bright yellow or	•
	ochraceous to gray; nodes yellow or yellowish, rarely white	. P. tenerum
s.	Stalks not calcareous, usually translucent.	t
	t. Base of peridium thickened, tending	
	to persist as a cup; nodes large, angular.	P. oblatum
	t. Base of peridium not notably thickened nor tending to	
	persist as a cup; nodes small; sporangia golden yellow	to chrome. u
u.	Stalk short, thick, red, rarely	
	attaining half the diameter of the sporangium; nodes small, rounded, abundant.	P. auripigmentum
u.	Stalk long, slender, orange below,	2 , a.ap.g
٠.	fading to yellow above, 1–3 times	
	diameter of sporangium; nodes small, angular, sparse.	P. galbeum
	Y VII	
a.	Capillitium robust, strongly calcareous, orange, the nodes often angular or rod-like, varying to	D. what down
_	long-fusoid; sporangia lenticular, often depressed above.	P. rigidum
a.	Capillitium delicate, dense, with small nodes.	b
	 Sporangia ovate, yellow, gray or pallid; stems weak, more or less recumbent; 	
	usually lobate or compound. Simple forms of	P. polycephalum
	b. Sporangia globose or oblate,	, , ,
	rarely compound; stems erect.	c

c. Dusky yellow or sooty, often nearly limeless; capillitium sometimes reticulate with angular nodes.

P. flavicomum

 Not dusky or sooty; capillitium consistently dichotomous with fusiform nodes.

Peridium iridescent blue, with scanty

d

e

d. Peridium usually distinctly limy, rarely iridescent: stalks usually long and sporangia then nodding

P. bethelii

iridescent; stalks usually long and sporangia then nodding. Gray or white; nodes white.

yellow lime deposits; erect on a short, thick stem.

P. nutans

 Yellow, greenish yellow or orange, often fading; nodes yellow or orange.

e.

P. viride

Physarum aeneum R. E. Fries, Ark. Bot. 1: 62. 1903.

Physarum murinum var. aeneum A. Lister, Jour. Bot. 36: 117. 1898.

FIG. 230 Plate XXV

Plasmodiocarpous, 0.3–0.4 mm in width, the plasmodiocarps usually accompanied by sessile, subglobose, sporangiate fruitings, pinkish brown or citrine-drab to bronze, glossy; peridium double, the outer layer cartilaginous, brittle, wrinkled, shining, sometimes bearing lime deposits, usually separating at dehiscence from the shining, iridescent, membranous inner wall; capillitium dense, the nodes small, brown, sometimes aggregated to form a pseudocolumella; spores brown in mass, rather pale yellow-brown by transmitted light, very minutely punctate, sometimes bearing clusters of larger and darker warts, 7–9 μ in diameter. Plasmodium black.

TYPE LOCALITY: Bolivia.

HABITAT: Dead leaves and wood.

DISTRIBUTION: New York to Iowa and Kansas, south to Virginia, Louisiana, and Texas, and in the West Indies; South America; India; Japan; Hawaii. ILLUSTRATIONS: Jour. Bot. 36, pl. 385, f. 4, a-c; Lister, Mycet. ed. 3. pl. 58.

The shining peridium and the brown nodes associated with the plasmodiocarpous habit, make this species easy to recognize. Sporangiate fruitings, when present, are usually in groups suggesting an interrupted plasmodiocarp. In figure 230, c and d, the clusters of warts on the spores are overemphasized. In some collections they are scarcely perceptible.

Fries was not sure that his specimen was the same as A. Lister's variety aeneum of P. murinum, and was justifiably convinced that it was entirely distinct from P. murinum. Hence, his epithet was independently applied, and the citation "(A. Lister) R. E. Fries" is incorrect, although there can be little doubt that Lister's variety and Fries's species are the same.

Although widely distributed, the species appears to be uncommon.

Physarum albescens Ellis, ex Macbr., N. Am. Slime-Moulds ed. 2. 86. 1922.

Leocarpus fulvus Macbr., N. Am. Slime-Moulds 82. 1899.

Physarum fulvum (Macbr.) G. Lister, Mycet. ed. 2. 60. 1911. Not P. fulvum Fries, 1829.

FIG. 231 Plate XXV

Sporangia gregarious or scattered, obovoid or globose, sessile or borne on a weak strand-like stalk, 0.6–0.8 mm in diameter, occasionally subplasmodio-carpous, white, pale yellow or fulvous or dark from lack of lime, irregularly dehiscent above; peridium double, the outer layer calcareous, white or yellow, to fulvous, darker below, the inner delicate, membranous, iridescent, the two persistent below as a shallow cup; stalk, when present, variable in length,

weak, striate, fulvous or yellow, arising as an extension of the venulose or more or less continuous hypothallus; capillitium dense, dark to yellow then fading to pallid or white, often nearly limeless above, the nodes large, flattened and usually more deeply colored below, where they are sometimes massed, smaller, and scanty above; spores black in mass, dark violaceous brown by transmitted light, distinctly warted, 12–15 μ in diameter. Plasmodium yellow.

TYPE LOCALITY: Colorado.

HABITAT: Fallen leaves and woody debris.

DISTRIBUTION: Wisconsin to British Columbia, south to Florida and Cali-

fornia; Switzerland.

ILLUSTRATIONS: Macbride, N. Am. Slime-Moulds, pl. 16, f. 4, 4a; Lister, Mycet. ed. 3. pl. 66; Macbr. & Martin, Myxom. pl. 6, f. 107, 108.

Macbride published this as *Physarum albescens* Ellis. It is clear that Ellis had nothing to do with the description, his only part having been to send to Macbride specimens misdetermined by Harkness as *Diderma albescens* Phill. (= *D. niveum* (Rost.) Macbride), with the suggestion that it might be a *Physarum*. A specimen from Colorado sent by Bethel to Macbride was the basis for *Leocarpus fulvus* Macbr., and must be the type. Later, excellent material reached Macbride from Colorado and he transferred the *Leocarpus* to *Physarum*, applying to it the epithet *albescens*, since *fulvum* was already preempted in that genus.

This is a most distinctive species. The pale, firm peridium of some collections suggests that of a *Diderma*. The upper part, in breaking away, often leaves a sharply defined cup, with the pale, closely knit capillitium retaining its form.

Both Macbride's original drawing and that of Lister show the capillitium as strongly flattened, approaching that of *Leocarpus*. Mounts from some specimens show a capillitium which is only somewhat flattened, especially at the limeless nodes, while in others, not only are the strands flattened, but the capillitium is very dark. It is possible that two species are involved.

Physarum alpinum (A. & G. Lister) G. Lister, Jour. Bot. 48: 73. 1910.

Physarum virescens var. alpinum A. & G. Lister, Jour. Bot. 46: 216. 1908.

Primarily plasmodiocarpous, but varying to sporangiate, and then subglobose, sessile, 0.8–1.4 mm in diameter, dull yellow or ochraceous to bright chrome yellow, smooth or scaly; peridium double, the outer wall densely calcareous, separating irregularly from the membranous inner wall; capillitium dense, calcareous, the nodes large, yellow, more or less branched; spores black in mass, dark purple-brown by transmitted light, closely warted, 11–13 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Arolla, Switzerland.

HABITAT: Grass, leaves, and twigs.

DISTRIBUTION: Washington, California; Sweden; Switzerland.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 62, d-f; Macbr. & Martin, Myxom.

pl. 4, f. 62, 63.

EXSICCATI: Jaap, Myxom. Exs. 124.

The yellow or yellow-brown color, the double peridium with a tendency for the outer wall to flake off in patches, the yellow nodes and the dark, closely warted, and rather large spores are the marks of this species. The Lister illustration cited, based on a California collection, agrees perfectly with our other American material. Three specimens from Switzerland, two collected by Meylan, one distributed as Jaap 124, another which may be a part of the same number, and a third, very scanty, sent to Macbride by G. Lister, tend to be more plasmodio-

FIG. 232 Plate XXV carpous, with a firmer, paler and smoother outer peridium and somewhat more strongly warted spores than in the American specimens. It is possible that the latter, and the Lister illustration, really represent phases of *P. virescens*, of which *P. alpinum* was at first regarded as a variety.

Physarum auripigmentum Martin, Jour. Wash. Acad. 38: 239. 1948.

Sporangiate, stalked, gregarious; sporangia globose, 0.4–0.6 mm in diameter, their total height 0.6–1 mm, clear to opaque yellow; peridium membranous, closely covered by subcircular limy scales; dehiscence somewhat petaloid; columella none; stalk cylindric, short, rarely exceeding half the diameter of the sporangium, often less, expanded at the base, orange-red, limeless, translucent; hypothallus scarcely evident; capillitium dense, delicate, persistent, the nodes small, rounded, bright yellow, many of the junctions limeless and with numerous free, pointed ends; spores dark brown in mass, clear yellow-brown by transmitted light, minutely warted, (8–)9–10(–11) μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Mt. Shasta, California.

HABITAT: Dead coniferous wood.

DISTRIBUTION: California, Washington.

ILLUSTRATION: Jour. Wash. Acad. 38: 239, f. 2.

The trim, globose sporangia with the bright yellow, flaked peridium mounted on short red stalks and the very delicate netted capillitium with the numerous small, yellow nodes are the marks of this species. Dr. Kowalski reports it as not uncommon on Mt. Shasta, always above 7000 feet.

Physarum auriscalpium Cooke, Ann. Lyc. N. Y. 11: 384. 1877.

Primarily plasmodiocarpous, the plasmodiocarps usually short, curved, sometimes branching or annulate, merging into sessile, pulvinate or subglobose sporangia, these sometimes narrowed at the base or rarely short-stipitate, orange, tawny or green, often fading to dingy white with age; peridium smooth, membranous, yellowish or smoky, dotted or netted with glossy, often anastomosing limy scales, especially above, often limeless at base; capillitium dense, composed of large, branching, orange, yellow or pallid limy nodes connected by short, hyaline tubules, or the tubules lacking and then badhamioid or the nodes free; spores black in mass, pale to rather dark brown by transmitted light, slightly roughened to minutely warted, (8-)9-12(-13) μ in diameter. Plasmodium orange or greenish.

TYPE LOCALITY: South Carolina.

HABITAT: Dead wood, woody debris, and moss. Frequent on bark from living trees in culture.

DISTRIBUTION: Maine to Ontario and Colorado, south to Florida, Louisiana, Texas, Arizona, southern California, and the West Indies; Portugal, Greece; Panama; Hawaii. Widely reported elsewhere, but the species as here delimited (following Farr) has apparently been confused with others, particularly *P. decipiens* and *P. serpula*.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 33; Brittonia 13: 341, f. 1-4.

Farr (Brittonia 13: 339-345. 1961) compared P. auriscalpium with P. decipiens and P. serpula, with which it has been confused. She does not give enough atten-

FIG. 233 Plate XXV

FIG. 234 Plate XXVI tion to the green phase. This appears in bark cultures more commonly than any of the other color phases, but tends to fade even more quickly than the others and many of our specimens which were a brilliant green when first dried, are now dingy white; others, equally old, have retained some of the green color. Lister's pl. 33, which may be based on the type, shows the short-stalked tawny phase. There is no reason to doubt its accuracy, but it is scarcely typical of the species as it usually appears. See comments under P. decipiens.

The species is not only variable in color, but in type of fructification. It appears to be primarily plasmodiocarpous, but some fruitings are largely, rarely entirely, composed of the pulvinate sporangia. In such cases, they are often arranged in such a way as to suggest interrupted plasmodiocarps. The stalked fruitings are rare in our material and are always accompanied by sessile or plasmodiocarpous phases.

Physarum limonium Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 69: 357. 1966, is, as noted by the author, very close to P. auriscalpium, from which it differs in the brilliant yellow color and the primarily stipitate habit. The spores and capillitium are also said to be different and are illustrated in Fig. 4 accompanying the description, but they could be regarded as falling within the limits of P. auriscalpium as we interpret that variable species. It should also be compared with P. citrinum. P. limonium is known from a number of collections in the Netherlands, and from Britain. It may well be distinct, but it may represent no more than another European phase of P. auriscalpium.

There is no "P. sulphureum Sturgis" as cited by G. Lister. Sturgis referred his specimen to P. sulphureum Alb. & Schw., noting and illustrating the strongly badhamioid capillitium. It cannot be that species as it is now interpreted, nor does it suggest P. auriscalpium as here defined. It is much like Badhamia citrinella Čel., Myx. Böhm. 76, pl. 4, f. 1, cited, with comment, in the Lister monograph as a synonym of P. auriscalpium.

Physarum bethelii Macbr., ex Lister, Mycet. ed. 2. 57. 1911.

Physarum viride var. bethelii (Macbr.) Sturgis, Colo. Coll. Publ. Sci. 12: 439. 1913.

Sporangia gregarious, stipitate, erect or nodding, depressed-globose, slightly umbilicate below, 0.6–0.8 mm in diameter, total height 1–1.5 mm; peridium iridescent blue, nearly limeless or covered with pale yellow or white calcareous scales, the lower portion remaining as a cup, sometimes forming short plasmodiocarps; stalk 0.5–1 mm in length, black or dark brown, furrowed, nearly equal; capillitium dense, very delicate, radiating from the black, slightly intrusive summit of the stalk and the base of the peridium; nodes not numerous, pale yellow, fusiform, occasionally branched; spores bright violet-brown, distinctly warted, (9-)10-11(-12) μ in diameter.

TYPE LOCALITY: Tolland, Colorado.

HABITAT: Dead wood.

DISTRIBUTION: Pennsylvania, Colorado, Washington; Netherlands; Rumania; Chile; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 200; Hattori, Myxom. Nasu pl. 17, f. 4.

Distinguished by its nearly limeless, iridescent peridium, largely erect habit, relatively short, stout stalk, and somewhat larger and darker spores from *P. viride* and *P. nutans*.

A rather doubtful species, as the comments in the Lister and Hagelstein monographs suggest. In what is apparently the type collection from Colorado, the sporangia which remain, except for a few plasmodiocarpous fruitings, have lost the upper part of the peridium, but enough remains to show that the peridium

FIG. 235 Plate XXVI was originally translucent and that the dark color was due to the included spores. A collection from the Netherlands, by Nannenga-Bremekamp, is younger and still darker, but is accompanied by a few fruitings which suggest *P. nutans* rather than *P. viride*. The spores of both collections are darker and larger than those of either of these species. A collection from Washington by Macbride is typical of the species as described but very scanty. On the other hand a collection from Colorado by Sturgis and noted as confirmed by G. Lister and Meylan seems quite different. It is now nearly white with only faint suggestions of yellow. It may have faded and may be part of the collection illustrated by G. Lister in *pl. 200*, Mycet. ed. 2. 1911 and reproduced under the same number in the third edition. Whether the species has been misinterpreted or is in reality based only on nearly limeless forms of other species remains uncertain. A collection from Chile is for the present referred here.

Physarum bilgramii Hagelst., Mycologia 33: 306. 1941.

Physarum lilacinum Sturgis & Bilgr., in Sturgis, Mycologia 9: 324. 1917. Not P. lilacinum Fries, 1829.

Sporangia gregarious, stalked, globose, erect, 0.4–0.6 mm in diameter, 1–1.5 mm tall, pale lilac, pale Indian red, or pale blue; peridium membranous, bearing clusters of colored lime granules; columella short, conical; stalk erect, furrowed, calcareous, tapering upward, concolorous with the sporangium or paler, to white, 0.5–1 mm tall, about 0.1 mm in diameter; capillitium delicate, rigid, persistent, the nodes small, rounded, filled with large, spherical, lilac, blue, or reddish granules; spores pale lilaceous brown by transmitted light, minutely warted, 7-8(-11) μ in diameter. Plasmodium dark red or blue.

TYPE LOCALITY: Philadelphia, Pennsylvania.

HABITAT: Dead wood.

DISTRIBUTION: Known from eastern Pennsylvania and Texas.

Until 1965 this species was known only from several localities in eastern Pennsylvania, where it had been found at times in abundance. In that year, Dr. Henry Aldrich collected a blue plasmodium on rotting wood in Austin, Texas, which, when placed in moist chamber, produced several well-formed blue sporangia with concolorous stalks and nodes. As noted in the original description, this species is very close to *P. globuliferum*, but its constancy in widely scattered areas and the different color of the plasmodium justify retaining it as distinct.¹

The var. coeruleum G. Lister, Mycet. ed. 3: 30. 1925, was applied to forms with pale-blue peridium, stalk and nodes. One of Bilgram's collections in the Iowa herbarium answers to this description, but has all the marks of a somewhat prematurely dried collection. The varietal name seems unnecessary.

Physarum bitectum G. Lister, Mycet. ed. 2. 78. 1911.

Sporangiate, sessile, subglobose, 0.6-0.8 mm in diameter, or forming short, usually unbranched plasmodiocarps up to 6 mm long, smooth, white or pallid,

¹ Dr. Mary Henney has recently collected a blue plasmodium in Bastrop, Texas, which, upon fruiting, also produced blue sporangia with concolorous stalks and capillitial nodes. Spores from these sporangia when plated on agar yielded white plasmodia which produced white sporangia indistinguishable from those of *P. globuliferum* collected in the same locality at the same time. Both the blue and white forms proved to be heterothallic. Several clones derived from blue sporangia (*P. bilgramii*) were successfully crossed with clones derived from white sporangia (*P. globuliferum*). All crosses gave rise to white plasmodia which produced sporangia typical of *P. globuliferum*. From these results it appears that *P. bilgramii* is no more than a blue-pigmented form of *P. globuliferum*, produced as a response to environmental factors as yet undetermined.

FIG. 236 Plate XXVI

FIG. 237 Plate XXVI terete or slightly compressed; peridium double, the outer wall calcareous, free, deciduous above, recurved and persistent below, the inner side smooth, white or purple, inner peridium hyaline, colorless or purplish, persistent; dehiscence irregular, by the breaking away of the upper part of the peridium; capillitium of large, white nodes connected by short, hyaline tubes; spores black in mass, dark violaceous brown by transmitted light, coarsely and irregularly spiny, sometimes with conspicuous smoother areas, 10–13 μ in diameter. Plasmodium white.

TYPE LOCALITY: Great Britain. HABITAT: Dead leaves and twigs.

DISTRIBUTION: Western Europe; in North America, Ohio to Manitoba and Washington, south to Kansas, Colorado and California; Puerto Rico; Colombia; South Africa; Australia; New Zealand.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 51.

EXSICCATI: Jaap, Myxom. Exs. 146.

Probably commoner and more widespread than the records show. P. bitectum has certainly been confused with other species, particularly P. bivalve, from which it differs in the darker, rougher and larger spores and the terete or less strongly compressed plasmodiocarps. G. Lister stresses the smooth area on the spores. This is not always apparent. The English collections in our material and one from California show the purple color on the inside wall of the outer peridium; in most of the others it is paler. P. bitectum never shows the marked longitudinal dehiscence of P. bivalve. As sometimes happens in other species with non-crystalline lime, we have a specimen from Oregon in which the lime on some of the plasmodiocarps is crystalline in patches. This may be due to droplets of water which have partly dissolved the lime, which has then dried in crystalline form.

A. Lister, Jour. Bot. 29: 260. 1891 reported this species as *P. diderma* Rost., and this was repeated in the later editions of the Mycetozoa. This does not, of course, constitute effective publication of "*P. diderma* A. Lister."

Physarum bivalve Pers., Ann. Bot. Usteri 15: 5. 1795.

FIG. 238 Plate XXVI Reticularia sinuosa Bull., Hist. Champ. Fr. 94. 1791.

Angioridium sinuosum (Bull.) Grev., Scot. Crypt. Fl. pl. 310, 1827.

Diderma valvatum Fries, Syst. Myc. 3: 109. 1829.

Physarum sinuosum (Bull.) Weinm., in Fries, Syst. Myc. 3: 145. 1829. Not P. sinuosum Link, 1809.

Carcerina valvata (Fries) Fries, Summa Veg. Scand. 451. 1849.

Plasmodiocarpous, crowded, laterally compressed, white, gray, or yellowish, the plasmodiocarps usually interspersed with shortened, sporangiate fructifications, these sometimes with a constricted base; peridium double, the outer layer usually thickly calcareous, especially above, and then white, sometimes nearly limeless below and then drab or yellowish, the inner wall delicate, colorless; dehiscence by a more or less regular, preformed longitudinal fissure; capillitium abundant, the nodes large, white; spores black in mass, dull violet by transmitted light, minutely and uniformly spinulose, 8–10 μ in diameter. Plasmodium gray, pallid, or yellowish.

TYPE LOCALITY: France.

HABITAT: Dead leaves and accompanying debris.

DISTRIBUTION: Throughout Europe, Canada and the United States; widely distributed elsewhere, including Costa Rica, Chile, South Africa, Pakistan, India, Ceylon, Java, Japan, Samoa, the Philippines.

ILLUSTRATIONS: Bull., Herb. Fr. pl. 446, f. 3; Grev., Scot. Crypt. Fl. pl. 310; Lister, Mycet. ed. 3. pl. 49; Macbr. & Martin, Myxom. pl. 4, f. 57-59; Hattori, Myxom. Nasu pl. 18, f. 6.

EXSICCATI: Ellis. N. Am. Fungi 1394; Sydow, Myc. Germ. 33; Jaap, Myxom. Exs. 4, 86, 145; Brândză, Myxom. Roum. 27(IA); Hintikka, Myxogast. Fenn. 15: Thaxter, Rel. Farl. 410.

A very variable, but distinctive species. The fruitings may be in the form of very complex netted plasmodiocarps, or of shorter plasmodiocarps, either interspersed with small, almost sporangiate fruitings which look like minute clams seated on the hinged edge or rarely restricted to these. The amount of lime on the outer peridium is also very variable; fruitings with nearly or quite limeless peridia occur, but the nodes in such are usually well-developed.

"Diderma contortum Fckl.," cited by G. Lister, Mon. ed. 3: 58, 1925 as a synonym, has no existence. Fuckel erroneously referred his specimens to D. contortum Hoffm. "Angioridium valvatum Fries" ex Berlese, in Sacc., Syll. 7: 347. 1888, is likewise a myth. Fries, Syst. Myc. 3: Index 51. 1832, merely suggested that Diderma valvatum and Physarum sinuosum might be synonyms of A. sinuosum (Bull.) Grev.

Physarum bogoriense Racib., Hedwigia 37: 52. 18 F. 1898.

Physarum pallidum A. Lister, Jour. Bot. 36: 117. Ap. 1898.

Sporangiate, globose, sessile or forming elongate and often reticulate plasmodiocarps, semicircular in transverse section, 0.3–0.6 mm wide; peridium triple, the two outer layers closely compacted, the outer layer smooth, yellow or brown, the middle layer white, the two together breaking up into angular fragments above, and at the sides often dehiscing in stellate fashion into persistent, more or less triangular, reflexed lobes, remote from the thin, colorless or somewhat iridescent and early evanscent inner layer; capillitium abundant, of white, rounded or branching lime-knots connected by slender, hyaline threads; spores dark brown in mass, bright violet-brown by transmitted light, minutely warted, sometimes clustered, 7.5–10 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Buitenzorg, Java.

HABITAT: Dead leaves and plant litter.

DISTRIBUTION: New York to California and southward to Panama; ?Portugal, Czechoslovakia, Rumania; South America; South Africa; Asia; Australia; abundant in the tropics of both hemispheres.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 50; Hattori, Myxom. Nasu pl. 6, f. 3.

EXSICCATI: Ellis & Ev., Fungi Columb. 1396 (as Physarum conglomeratum (Fr.) Rost.).

Chiefly tropical. A collection in Panama was found on the under side of a dead branch about six feet above ground, with the plasmodiocarps free from the substratum and suspended by slender filaments of the hypothallus much as in some collections of *Erionema aureum*.

The wall appears to be triple, the two outer layers very closely attached but the brown outer layer tending to be broken into patches at maturity; the very delicate inner layer seems to disappear very quickly and is not present in old and weathered specimens. Dr. Kowalski, in correspondence, reports that he has examined

FIG. 239 Plate XXVI Raciborski's type and finds that the spores are clustered, as they are in one of his northern California collections and in Plunkett's 182 from southern California.

Reported from Portugal but our two specimens, from Torrend, appear to approach P. bitectum, although not typical of either species.

Physarum braunianum de Bary, in Rost., Mon. 105. 1874.

FIG. 240 Plate XXVI

FIG. 241

Sporangia sessile, subglobose to erect-ovate, (0.1-)0.3-0.5 mm in diameter, scattered or clustered but not heaped, brown or reddish brown, speckled with pale spots, or with scanty lime and then darker when filled with spores; peridium membranous, colorless except for included clusters of yellow or red lime-granules and occasional red streaks; capillitium a network of small, angular or branching, deep ochraceous or brownish nodes connected by hyaline threads; spores dark brown in mass, violet-brown by transmitted light, spinulose, 8–10 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Germany. HABITAT: Dead leaves.

DISTRIBUTION: Europe; In the eastern United States reported from Maine to Florida; Iowa.

ILLUSTRATION: Macbr. & Martin, Myxom. pl. 4, f. 51, 52.

In the third edition of the Lister Monograph, this species is included under P. lateritium. The spore of the type is illustrated under that species as fig. d of pl. 59. Hagelstein (Mon. p. 75) notes that P. braunianum is distinguished from P. lateritium by the smaller sporangia, absence of plasmodiocarpous fruitings, angular lime-knots and different wall and color. Very short plasmodiocarps, suggesting fused sporangia, may occasionally occur.

The species appears to be rare in North America and has certainly been confused with others, but is maintained provisionally.

Physarum brunneolum (Phill.) Massee, Mon. 280. 1892.

Diderma brunneolum Phill., Grevillea 5: 114. 1877. Plate XXVI

Sporangia gregarious or scattered, stipitate or sessile, globose, turbinate, or somewhat depressed, rarely plasmodiocarpous, (0.4-)0.6-1.7 mm in diameter; peridium thick, smooth, crustose, shining, double, the outer layer cartilaginous, yellow-brown, closely appressed to the white, calcareous inner layer; dehiscence stellate or sometimes irregular, often leaving the lower portion as a cup; stalk when present short, stout, cylindric, furrowed, dark reddish brown, arising from a small hypothallus; columella none, but a pseudocolumella sometimes present; capillitium dense, the nodes numerous, large, white, irregular, the internodes thin, short, colorless; spores globose, rather dark, coarsely warted, 8-10(-12) μ in diameter. Plasmodium yellow.

TYPE LOCALITY: California.

HABITAT: Dead wood and fallen leaves.

DISTRIBUTION: Colorado, Montana, California; Chile; Europe; Australia.

ILLUSTRATIONS: Grevillea 5: pl. 87, f. 4; Massee, Mon. pl. 9, f. 221, 222; Lister, Mycet. ed. 3. pl. 69.

The shining double peridium does suggest Diderma. The capillitium approaches that of Badhamia. These characters, and the dark, strongly marked spores, are the distinctive characters of this species.

Physarum carneum G. Lister & Sturgis, Jour. Bot. 46: 73. 1910.

Sporangia gregarious, stipitate, subglobose, 0.4–0.6 mm in diameter, rarely sessile or forming short plasmodiocarps, ochraceous yellow above, flesh-colored below, often fading to dingy white; peridium membranous, pale yellow, covered with evenly distributed lime granules or gray from the absence of lime; stalk cylindrical, usually rather short, rarely exceeding diameter of sporangium, expanded at base, translucent, flesh-colored; capillitium dense, the nodes white; spores black in mass, purplish brown by transmitted light, paler at one side, spinulose, 8–9 μ in diameter. Plasmodium mustard yellow (Lister); white according to H. C. Gilbert.

TYPE LOCALITY: Colorado Springs, Colorado.

HABITAT: Dead wood and twigs.

DISTRIBUTION: Colorado, Montana, Washington, Oregon, California; Eng-

land, Portugal, Rumania.

ILLUSTRATION: Lister, Mycet. ed. 3. pl. 204. EXSICCATI: Brândză, Myxom. Roum. 3(IA).

Characterized by the flesh-colored lime of the peridium and the color of the stem. In old fruitings, the lime tends to disappear and the thin sporangial wall then appears dark from the enclosed spore mass.

Physarum cinereum (Batsch) Pers., Neues Mag. Bot. 1: 89. 1794.

Lycoperdon cinereum Batsch, Elench. Fung. 155. 1783.

Didymium cinereum (Batsch) Fries, Syst. Myc. 3: 126. 1829.

Physarum plumbeum Fries. Syst. Myc. 3: 142. 1829.

Didymium scrobiculatum Berk., Lond. Jour. Bot. 4: 66. 1845.

Didymium oxalinum Peck, Ann. Rep. N. Y. State Mus. 28: 54. 1876.

Physarum scrobiculatum (Berk.) Massee, Mon. 300. 1892.

Sporangia sessile, closely gregarious, crowded or heaped, subglobose, or elongate, merging into short plasmodiocarps, 0.3–0.5 mm broad, calcareous, white or cinereous, or nearly limeless and iridescent to drab; peridium single, thin, more or less densely coated or flecked with lime; capillitium abundant, the nodes often angular and with the calcareous deposits extending into the internodes; spores purplish brown in mass, clear violaceous by transmitted light, minutely warted, (7-)9-11(-12) μ in diameter. Plasmodium watery-white or colorless; said to become at times bright yellow before fruiting.

TYPE LOCALITY: Germany.

HABITAT: Often forming extensive fruitings on living plants; also on dead leaves and surface litter.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 47; Hattori, Myxom. Nasu pl. 6, fig. 4.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2085, 2691, 3496; Jaap, Myxom. Exs. 166; D. Sacc., Myc. Ital. 930, 1114; Brândză, Myxom. Roum. II. 1: 19(NY).

Both the Lister and Hagelstein monographs give the spore range as 7–10 μ . Most of our specimens have spores in the 9–11 μ range.

This extremely common species appears frequently on lawns, often fruiting in fairy rings up to several feet in diameter. It has been reported as killing grass and

FIG. 242 Plate XXVI

FIG. 243 Plate XXVII occasionally herbaceous plants and the shoots of woody plants. When the plasmodium masses on succulent shoots, there is no doubt it may kill them and we have reports and verifying specimens which show this on several plants, notably alfalfa and St. Augustine grass (Stenotaphrum secundatum, used for lawns in the south), and on young shoots of Azalea. However, while locally and temporarily striking, the actual damage done is insignificant.

The Lister monograph (1925) cites Trichia coerulea Trent., in Roth, Cat. Bot. 1: 229. 1797; Physarum violaceum Schum., Enum. Pl. Saell. 2: 199. 1803; and Physarum capense Rost., Mon. 113. 1874, as possible synonyms of P. cinereum and also comments on Physarum conglobatum Ditm., in Sturm, Deuts. Fl. Pilze 1: 40. 1814, cited by Rostafinski as a synonym. The var. scintillans Brândză, Ann. Sci. Univ. Jassy 11: 122. 1921, is, as G. Lister points out, redundant. "Physarum cinereum Link," cited by G. Lister as a possible synonym of Badhamia capsulifera, was not intended as a new name, but was merely a comment on what Link regarded as an aberrant form of Persoon's species. "Physarum cinereum A. Lister," cited by G. Lister, Mycet. 55. 1894, was not published as a new name but merely indicates that A. Lister's conception of P. cinereum was broader than that of later authors and included forms which are now segregated. See also comments under P. sessile Brândză, and P. vernum Somm.

The species is very close to *P. vernum* and to the white phase of *P. confertum* as the latter also occurs on living grass. G. Lister, Mon. ed. 3. 53. 1925, says "it is connected by intermediate forms with *P. vernum*." This is apparently true. The more plasmodiocarpous fruitings of *P. vernum*, with thicker walls and somewhat larger and darker spores may be associated with its fruiting on dead wood and stems rather than on living plants. Pending experimental study, however, it seems convenient to keep the three species distinct.

Physarum citrinum Schum., Enum. Pl. Saell. 2: 201. 1803.

FIG. 244 Plate XXVII Physarum compactum Ehrenb., Sylvae Myc. Berol. 26. 1818. Not. P. compactum (Wing.) A. Lister, 1894.

Physarum schumacheri Spreng., Syst. 4(1): 528. 1827.

Diderma citrinum (Schum.) Fries, Syst. Myc. 3: 100. 1829.

Cytidium citrinum (Schum.) Morgan, Jour. Cinc. Soc. Nat. Hist. 19: 9. 1896.

Sporangia gregarious or scattered, subglobose, somewhat flattened below, 0.4–0.7 mm in diameter, bright ochraceous to pale yellow or pallid, stipitate or rarely sessile; peridium thin, almost completely covered with small, calcareous scales; stalk calcareous, stout, erect, furrowed, tapering upward, yellow, opaque, very short to more than half the total height, arising from a small hypothallus; columella small, conic, or depressed-conic, yellow, sometimes lacking or replaced by a pseudocolumella; capillitium dense, delicate, the nodes numerous, small, rounded, yellow, the connecting threads hyaline, rigid, with many junctions nodeless; spores black in mass, violaceous under the lens, minutely punctate, $8-10~\mu$ in diameter. Plasmodium yellow.

TYPE LOCALITY: Germany.

HABITAT: Dead wood and moss.

DISTRIBUTION: Cosmopolitan, but mainly in wooded, temperate areas; rare in North America.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 20; Hattori, Myxom. Nasu pl. 6, f. 5.

EXSICCATI: Brândză, Myxom. Roum. II 1: 3(NY).

Distinguished by the yellow peridium and stalk, which may, however, be nearly white in some collections, and by the very firm and delicate capillitium

bearing numerous small, rounded, yellow nodes, which may retain its shape long after the peridium has disappeared.

Léveillé seems to have regarded this as a variety of *P. viride* Pers., and *P. aureum* var. chrysopus Lév., according to all editions of the Lister monograph, included the present species. Rostafinski, Mon. App. 7. 1876, based *P. leveillei* Rost. on the variety chrysopus of Léveillé, but apparently this included both *P. viride* and *P. citrinum*.

As Hagelstein, Mycet. N. A. 39. 1944, notes, typical examples of this species are very rare in North America, and he mentions its similarity to *P. globuliferum*, suggesting it may be no more than a color variation of that species. Since our material is scanty and unsatisfactory, the species is retained pending further information.

Physarum compressum Alb. & Schw., Consp. Fung. 97. 1805.

Physarum nephroideum Rost., Mon. 93. 1874 (as nefroidium).

Physarum affine Rost., Mon. 95, 1874.

Physarum candidum Rost., Mon. 96. 1874.

Didymium glaucum Phill., Grevillea 5: 114. 1877.

Physarum phillipsii Balf. f., in Cooke, Grevillea 10: 116. 1882.

Physarum glaucum (Phill.) Massee, Mon. 284. 1892.

Sporangia scattered or gregarious, stipitate or less commonly sessile, 0.8–1.5 mm in greatest diameter, fan-shaped, compressed-globose, compressed-reniform, varying to lobate or plasmodiocarpous, calcareous, white or cinereous; total height up to 1.5 mm; peridium single, thin, squamulose, opening by an apical cleft or irregularly; stalk when present short, stout, sulcate, dark brown or frosted with lime; capillitium rather loose, the nodes white, variable in size and shape; spores purplish brown, warted, the warts sometimes irregularly distributed, $10-12.5~\mu$ in diameter. Plasmodium grayish white.

TYPE LOCALITY: Germany.

HABITAT: Dead leaves and other plant debris.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 39; Macbr. & Martin, Myxom. pl. 5, f. 93-95; Hattori, Myxom. Nasu pl. 6, f. 1.

EXSICCATI: Jaap, Myxom. Exs. 165, 183; Thaxter, Rel. Farl. 809.

In its typical expression, *P. compressum* is readily recognized by the fanshaped sporangia, but the flattening may not be very apparent, and the head may be lobate approaching *P. nicaraguense* and *P. polycephalum* in that respect. *Tilmadoche reniformis* Massee, which G. Lister regarded as an earlier specific name for what Macbride called *P. nicaraguense*, may be in part *P. compressum* and in part a distinct species, but available material does not permit definite decision. See comments under *P. nicaraguense*. A collection from Chile (Lazo 9) was deep green when first received. After some years it is still green, but duller.

Physarum lepidoideum H. C. Gilbert, Am. Jour. Bot. 19: 123. 1932 was based on a specimen in which the peridium was covered with scales suggesting those of Lepidoderma and spores $12-14~\mu$ in diameter. Hagelstein (1944, p. 60), regarded it as a sessile phase of P. compressum in which the lime had been dissolved and rehardened into the plates. Martin (1949) recognized the species. It is possible that Hagelstein's interpretation is correct, and since the species is as yet unknown except for the type collection, which we have not seen, we enter it here tentatively.

Physarum confertum Macbr., N. Am. Slime-Moulds ed. 2. 64. 1922.

Sporangiate, subglobose, or somewhat elongate, sessile, small, 0.2-0.4 mm in diameter, closely gregarious, often confluent or heaped, rarely scattered and

FIG. 246
Plate XXVII

FIG. 245

Plate XXVII

then larger, or plasmodiocarpous or rarely effused, dull violaceous brown to blackish, less commonly white; peridium single, thin, more or less transparent, nearly limeless or sprinkled or reticulated with lime; capillitium scanty, the nodes small, elongate, rounded, white, many junctions limeless; columella none; spores violet-brown, minutely warted, $10-13~\mu$ in diameter. Plasmodium white.

TYPE LOCALITY: North Carolina.

HABITAT: Pine needles, moss, twigs, and dead wood; often in Sphagnum bogs.

DISTRIBUTION: Nova Scotia to Ontario, south to North Carolina, Mississippi and Arizona; Finland, Great Britain, Germany, Rumania.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 64.

EXSICCATI: Hintikka, Myxogast. Fenn. 14; Brândză, Myxom. Roum. II 1: 12(NY as P. atrum); 38(IA).

The plasmodium, on its substratum, may be quite dark from included material, but when this is ejected before fruiting it is white.

The dense clusters of small dark sporangia are rather inconspicuous until fully mature, when the mass of exposed spores gives them a sooty, smut-like appearance on the moss shoots which appear to be a favorite substrate.

Morgan, Jour. Cinc. Soc. Nat. Hist. 19: 27. 1896, referred this species incorrectly to *P. atrum* Schw. That is the source of "*Physarum atrum* Morgan" cited by G. Lister, Mycet. ed. 3. 54. 1925, which was never validly published. She also cites *P. reticulatum* Berl., in Sacc., Syll. Fung. 7: 350. 1888, as a synonym. Since Berlese based his name, which is a later homonym of *P. reticulatum* Alb. & Schw. 1803, on *P. atrum* Schw., such synonymy would seem at best doubtful. As G. Lister remarks, the white forms are close to *P. cinereum*. This resemblance is especially deceiving when they fruit on living grass, as occasionally happens.

A specimen from North Carolina so labelled by Macbride has been designated as the type. Another specimen, similarly labelled, has exactly the appearance of the type, but the spores are very regularly $14.5-15.5 \mu$ in diameter.

Physarum conglomeratum (Fries) Rost., Mon. 108. 1874. Not P. conglomeratum Massee, 1892.

Diderma conglomeratum Fries, Syst. Myc. 3: 111. 1829.

Carcerina conglomerata (Fries) Fries, Summa Veg. Scand. 451. 1849.

Sporangia subglobose, sessile on a broad base, crowded and often angular by mutual pressure, pale yellow to buff, often mottled, 0.3–0.5 mm in diameter; sporangium wall double, the outer layer limy, fragile, the inner layer pale yellow, translucent, sometimes bearing pale yellow, translucent thickened areas, with a vitreous fracture; capillitium with numerous white or yellow angular nodes, sometimes confluent, or connected by slender hyaline tubules; spores black in mass, pale violet-brown by transmitted light, almost smooth, 8–10 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Europe. HABITAT: Forest litter.

DISTRIBUTION: Europe; India. Reported from North America, but these reports are doubtful.

ILLUSTRATION: Lister, Mon. ed. 3, pl. 56.

There has been much question about this species. As G. Lister points out, the most striking difference between it and *P. contextum* is in the smaller, paler, and smoother spores and the older reports do not give such details. We have no speci-

mens and hence do not illustrate it. It should occur in North America and possibly detailed examination of collections now referred to *P. contextum* or *P. mortoni* might reveal some which agree with *P. conglomeratum*. G. Lister's *pl.* 55, of *P. contextum*, is on the same page as *pl.* 56, of *P. conglomeratum*, thus permitting direct comparison of the two species as understood by her. *Pl.* 55, of *P. contextum*, does not show the crowding nor the sunken lids often observable in that species.

Lister (1925) cites a number of names which may or may not be synonyms of either *P. conglomeratum* or *P. contextum*. Unless type or authentic material can be examined, they cannot be determined from the descriptions, but may be cited for the record. These are: Spumaria minuta Schum., Enum. Pl. Saell. 2: 196. 1803; Spumaria granulata Schum., Enum. Pl. Saell. 2: 196. 1803; Diderma granulatum (Schum.) Fries, Syst. Myc. 3: 110. 1829; Diderma minutum (Schum.) Fries, Syst. Myc. 3: 111. 1829; Diderma flavum Weinm., Fl. Ross. 593. 1836; Diderma rugulosum Weinm., Fl. Ross. 594. 1836; and Leocarpus granulatus (Schum.) Fries, Summa Veg. Scand. 451. 1849.

"Physarum ochraceum Hoffm." See comment under Diderma ochraceum.

Physarum contextum (Pers.) Pers., Syn. Fung. 168. 1801.

Diderma contextum Pers., Obs. Myc. 1: 89. 1796.

Didymium contextum (Pers.) Fries, Symb. Gast. 20. 1818.

Leocarpus contextus (Pers.) Fries, Summa Veg. Scand. 450. 1849.

Diderma ochroleucum Berk. & Curt., in Berk., Grevillea 2: 52. 1873.

Chondrioderma contextum (Pers.) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27–28: 74. 1873.

Diderma flavidum Peck, Ann. Rep. N. Y. State Mus. 28: 54. 1876.

Physarum flavidum (Peck) A. Berl., in Sacc. Syll. Fung. 7: 350. 1888.

Physarum rostafinskii Massee, Mon. 301. 1892.

Physarum conglomeratum Massee, Mon. 304. 1892. Not P. conglomeratum (Fries) Rost. 1874.

Sporangiate or subplasmodiocarpous, sessile on a broad or less commonly constricted base, densely aggregated, oval, reniform or elongate, 0.3–0.6 mm wide, often united as a pseudoaethalium; peridium double, the outer layer thick, calcareous, yellow, ochraceous, or pallid, rarely pinkish buff at sides, often paler above and marginate and depressed; the inner layer membranous, pallid, or yellowish; capillitium dense, the nodes angular, white or yellowish; columella none, but pseudocolumella sometimes present; spores nearly black in mass, deep violet-brown by transmitted light, distinctly and irregularly spinulose, or sometimes coarsely warted, (10–)11–13(–14) μ in diameter. Plasmodium yellow.

TYPE LOCALITY: Germany.

HABITAT: Dead leaves and twigs, and herbaceous debris.

DISTRIBUTION: Widely distributed in Europe and North America; Pakistan; India; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 55; Macbr. & Martin, Myxom. pl. 6, f. 101, 102; Hattori, Myxom. Nasu, pl. 6, f. 2.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2086; Jaap, Myxom. Exs. 5; Brândză, Myxom. Roum. I. 1: 6; II. 1: 14; III. 1: 6(NY); 26(IA).

Readily recognized in the field except for its possible resemblance to P. conglomeratum, from which it is separated, as noted under that species, only by its FIG. 247 Plate XXVII darker, more strongly marked and usually larger spores. Massee's description of his *P. conglomeratum* suggests this species, but his illustrations do not and are not cited.

Physarum crateriforme Petch, Ann. Bot. Gard. Peradeniya 4: 304. 1909.

FIG. 248 Plate XXVII Sporangia stipitate or occasionally sessile, globose or clavate, becoming crateriform, 0.4–0.6 mm in diameter, 1–2 mm in total height, grayish white or pale brown; stalk, when present, opaque, conic, black, or black below and white above; columella variable, sometimes cylindric and attaining the apex of the sporangium, sometimes shorter and then clavate or conic, concolorous with the stipe or paler, rarely lacking; capillitium strongly calcareous, the nodes either massed about the columella or rod-like and ascending; spores dull lilac, closely spinulose, 10–13 μ in diameter. Plasmodium dull ochraceous.

TYPE LOCALITY: Ceylon.

HABITAT: Dead wood and herbaceous stalks and the bark of living trees.

DISTRIBUTION: Great Britain, Ireland; Portugal; Nigeria; Ceylon, India; Japan; ?Kentucky, ?Iowa, ?Kansas, Texas; Antigua.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 76; Jour. Ind. Bot. Soc. 33: 180. f. 3, A-G.

In our specimens, which are all scanty, the columella is not conspicuous and in a collection from Portugal, determined by G. Lister, it is definitely absent. However, the somewhat obpyriform, pale sporangia on stiff dark stalks, the angular nodes and the rather large, pale spores appear to be characteristic enough to justify regarding this as a good species. There seems to be no other species to which the Kentucky, Iowa and Kansas collections can be referred.

FIG. 249 Plate XXVII Physarum decipiens Curtis, Am. Jour. Sci. II. 6: 352. 1848.

Badhamia decipiens (Curt.) Berk., Grevillea 2: 66. 1873.

Physarum chrysotrichum Berk. & Curt., in Berk., Grevillea 2: 66. 1873.

Badhamia chrysotricha (Berk. & Curt.) Rost., Mon. App. 4. 1876.

Sporangia gregarious, sessile, depressed-globose, pulvinate, rarely with a short, weak stalk, or plasmodiocarpous, 0.3–0.7 mm in diameter, dull to bright yellow or orange; sporangial wall membranous, yellow, usually wrinkled or areolate, usually with included yellow calcareous scales; capillitium whitish, yellow or dull orange, strongly calcareous, nodes angular or branching, sometimes without connecting tubules; spores dull black in mass, rather pale violetbrown by transmitted light, minutely spinulose, $10-13~\mu$ in diameter.

TYPE LOCALITY: South Carolina.

HABITAT: Dead wood, often on associated mosses.

DISTRIBUTION: Nova Scotia to South Carolina, Ontario, and Ohio; California, not common; South America; western Europe to Greece; Asia; Hawaii; Australia.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 7; Macbr. & Martin, Myxom. pl. 2, f. 27, 28.

EXSICCATI: Brândză, Myxom. Roum. 121(NY), 63(IA).

This species has been greatly misunderstood. Jahn (1919) commented on it, but his remarks seem to apply to *P. auriscalpium*. Farr (1961) notes that *P. decipiens* has been confused with that species and with *P. serpula*. Some speci-

mens, like the one here illustrated, have a predominantly badhamioid capillitium but in the same fruiting and sometimes in the same sporangium, a physaroid capillitium may be found; other fruitings are predominantly or wholly physaroid. More recently, Farr (1967) has presented further evidence that *P. auriscalpium* may not be distinct from *P. decipiens*.

P. decipiens may be distinguished from the other two by its predominantly sporangiate fructifications, by the rugulose peridium with less prominent scales and by the slightly larger and uniformly marked and colored spores. It is distinctly intermediate between Badhamia and Physarum, but because of its obvious relationship with the two other Physarums, it seems best to retain it in Physarum.

Because of the uncertainty, the distribution data as given must remain provisional.

Physarum dictyospermum A. & G. Lister, Jour. Bot. 43: 112. 1905.

Sporangiate, sporangia subglobose, stalked or rarely sessile, erect, scattered, 0.5–0.6 mm in diameter, dull orange, dark chestnut or olive-brown, glossy; sporangium wall membranous, rather firm, orange, beset with minute yellow crystalline bodies; stalk 0.1–0.7 mm long, slender, black, enclosing dark amorphous material, sometimes yellow above when dusted with lime granules; columella black, conical or clavate, varying from short to two-thirds the height of the sporangium cavity; capillitium abundant, persistent, dichotomous, the nodes orange-red, fusiform, small, connected by a network of colorless tubules; spores pale purplish gray, reticulate, with 5–6 meshes to the hemisphere, or the reticulation irregular and sometimes incomplete, 10–11 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Stewart Island, New Zealand.

HABITAT: Dead wood.

DISTRIBUTION: New Zealand; New South Wales; Switzerland; Chile.

ILLUSTRATION: Lister, Mycet. ed. 3, pl. 30.

A rare species with a curiously scattered distribution. G. Lister, Mon. ed. 3: 35. 1925, suggests it may be related to *P. psittacinum*, which, however lacks a columella. The nodes of the capillitium are similar to those of *Physarum viride* and associated species.

We have no material and the description is based on the published records and on the illustration cited. It appears to be a distinctive species.

Physarum dictyosporum Martin, Brittonia 14: 183. 1962.

Primarily plasmodiocarpous, varying to sporangiate and sessile, 0.2–0.4 mm in diameter, the plasmodiocarps up to 4 mm long, often sinuous but rarely branched; peridium double, the outer peridium white, crustose, of firmly compacted lime, sometimes scantily developed, the inner peridium membranous, translucent, close but not firmly attached to outer; capillitium sparse to abundant, the nodes white, angular and irregular, sometimes massed at center as a pseudocolumella, spores globose, black in mass, yellow-brown by transmitted light, sparsely covered with coarse black warts, 1.5– 2μ tall, connected by stout membranes, giving them a strongly, somewhat irregularly reticulate appearance, with 11–20 meshes to the hemisphere, the body of the spores 8–10 μ in diameter, the over-all diameter 11–14 μ . Plasmodium white.

TYPE LOCALITY: Reese's Bog near Douglas Lake, Michigan.

FIG. 250 Plate XXVII HABITAT: Dead wood and litter under trees.
DISTRIBUTION: Michigan; Iowa; Kansas; Texas.
ILLUSTRATIONS: Brittonia 14: 181, f. 3; 182, f. 6, 7.

The rather small, but perfectly developed fruitings of the original culture appeared over a period of several weeks. The later fruitings tended to be more or less limeless. No plasmodiocarpous species of *Physarum* has similar spores. In another collection on wood from Iowa, the fruitings are mostly sporangiate but the spores and other characters are identical. In the specimens from Kansas and Texas the pseudocolumella is very apparent, less so in the others.

fig. 251 Plate XXVIII Physarum diderma Rost., Mon. 110. 1874.

Physarum testaceum Sturgis, Colo. Coll. Pub. Sci. 12: 18. 1907.

Physarum diderma Rost., var. testaceum (Sturgis) Harling, Svensk Bot. Tidskr. 46: 51. 1952.

Sporangiate; sporangia white or pale ochraceous, subglobose, sessile, usually on a constricted base, clustered, usually densely, on a prominent white limy hypothallus, about 1 mm in diameter, often polygonal from pressure; peridium double, the outer layer calcareous, thick, fragile, usually remote from the delicate, translucent, membranous inner membrane; capillitium abundant, the nodes large, white, angular, sometimes massed in center to form a pseudocolumella which may be hollow; spores black in mass, purplish brown by transmitted light, densely spinulose $(8-)10-12~\mu$ in diameter. Plasmodium unknown.

TYPE LOCALITY: Vicinity of Warsaw, Poland.

HABITAT: On bark of dead wood, usually associated with mosses.

DISTRIBUTION: Poland, Norway, Sweden; widely distributed in the United States but rarely collected, and many of the reports are in need of verification; India (foothills of the Himalayas).

ILLUSTRATIONS: Lister, Mycet. ed. 3, pl. 54; Macbride and Martin, Myxom. pl. 4, f. 60-61; Svensk Bot. Tidskr. 46: 49, f. 1.

Harling (1952) points out certain differences between the European specimens and those from the United States and proposes the varietal name cited for the latter. In our opinion, these differences do not go sufficiently beyond the range of expected variation in a species to justify a separate name. He also gives a modern translation of Rostafinski's original description which is helpful.

As noted under *P. bitectum*, that species has been confused with *P. diderma*. "P. diderma A. Lister 1891" and "P. diderma Macbr. 1922" were not validly published; both cited Rostafinski as the author.

FIG. 252 Plate XXVIII Physarum didermoides (Pers.) Rost., Mon. 97. 1874.

Spumaria? didermoides Pers., Syn. Fung. XXIX. 1801.

Diderma oblongum Schum., Enum. Pl. Saell. 2: 197. 1803.

Physarum conglobatum Fries, Symb. Gast. 3: 21. 1818. Not P. conglobatum Ditm. 1817.

Physarum atrum Schw., Trans. Am. Phil. Soc. II. 4: 257. 1832. Not P. atrum Fries, 1829.

Spumaria licheniformis Schw., Trans. Am. Phil. Soc. II. 4: 261. 1832.

Claustria didermoides (Pers.) Fries, Summa Veg. Scand. 451. 1849.

Didymium congestum Berk. & Br., Ann. Mag. Nat. Hist. II. 5: 365. 1850. Physarum lividum Rost., Mon. 95. 1874.

Physarum cinereum var. ovoideum Sacc., Michelia 2: 334. 1881.

Physarum reticulatum A. Berl., in Sacc. Syll. Fung. 7: 350. 1888. Not P. reticulatum Alb. & Schw. 1805.

Sporangia cylindric or ovoid, 0.4–0.6 mm wide, stipitate or sessile, white, becoming blue-gray as outer wall is shed, the upper part of the outer wall often remaining as a prominent cap, densely aggregated, crowded, or forming a pseudoaethalium; peridium double, the outer layer white, limy, crustose, readily shed, sometimes scantily developed, the inner layer membranous, translucent, but often bearing purplish deposits on inner surface; stalk, when present, white, often flattened or expanded, connate with others through the irregularly reticulate or expanded limy hypothallus; columella none, but a pseudocolumella often present; capillitium abundant, the nodes angular or rounded, connected by hyaline tubules; spores black in mass, very dark purplish brown by transmitted light, densely spiny, often angular or irregular in shape, 12–15 μ in diameter. Plasmodium white or watery gray.

TYPE LOCALITY: Sweden.

HABITAT: Dead wood, bark and debris.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 45, 46; Macbr. & Martin, Myxom. pl. 5, f. 88-90.

EXSICCATI: Jaap, Myxom. Exs. 144, 187 (as Diderma globosum); Thaxter, Rel. Farl. 412.

An extremely common and, because of its large fruitings, a rather conspicuous species. The var. lividum (Rost.) A. Lister was based on relatively limeless specimens, with other characters which occur, as Hagelstein (1944) points out, more or less at random in other collections. Rostafinski's two varieties, conglobatum (Fries) Rost. and licheniformis (Schw.) Rost., are likewise not distinct. The latter, based on Spumaria licheniformis Schw., Trans. Am. Phil. Soc. IV. 4: 261. 1832, was evidently based on pseudoaethalioid fruitings which do resemble lichens. Additional possible synonyms cited by G. Lister (1925) are Badhamia pulcherrima Speg., Ann. Mus. Nac. Cord. 11: 474. 1889, and Physarum platense Speg., Ann. Mus. Nac. Buenos Aires 6: 199. 1899.

Physarum digitatum G. Lister & Farq. in Farq. & Lister, Jour. Bot. 54: 128. 1916.

Physarum instratum Macbr., N. Am. Slime-Moulds ed. 2. 62. 1922.

Sporangia sessile, subglobose, obovoid or erect-cylindric, 0.2–0.4 mm in diameter, 0.3–1 mm high, closely crowded in clusters on a shining hypothallus, not superimposed, but often merged below so that the erect portions become lobes of the basal mass, sometimes united into a pseudoaethalium, clay colored or tawny to snuff brown; peridium thin, covered with minute calcareous scales; columella none; capillitium lax, sometimes scanty, the nodes small, often fusiform, yellowish or brownish, sometimes confluent; spores dull, dark lilaceous in mass, pale violet by transmitted light, almost smooth or bearing scattered clusters of minute warts 6–8 μ in diameter. Plasmodium grayish yellow.

TYPE LOCALITY: Southern Nigeria.

HABITAT: Dead wood.

DISTRIBUTION: Nigeria; Pennsylvania to Washington, south to Maryland and Nebraska.

FIG. 253 Plate XXVIII ILLUSTRATIONS: Jour. Bot. 54, pl. 541, f. 1; Lister, Mycet. ed. 3. pl. 203; Macbr. & Martin, Myxom. pl. 4, f. 53, 54.

The sporangia of the type collection, as illustrated, are more cylindrical than in any of our specimens, possibly because of the circumstances of their collection, as related in connection with the original description. The species was well known in the United States long before it was described from Nigeria. Morgan referred it to *P. thejoteum* Fries, Symb. Gast. 3: 21. 1818, now regarded as a synonym of *P. virescens*, and it has frequently been cited as "*P. thejoteum* Morgan" but this name was never validly published. Several of Morgan's collections in the Iowa herbarium, dated from 1893 to 1897, are labelled in his hand "*Physarum stipatum* Morgan." Despite the range of years during which Morgan used the name, we find no record of its publication.

The species is closest to *P. confertum*, which it resembles in its dense masses of small, dark sporangia, often fused into pseudoaethalia. It differs from that species in its browner sporangia, its lesser tendency to form heaped clusters, its brown capillitium, and especially in its much smaller, paler and smoother spores.

FIG. 254 *Plate* XXVIII

Physarum echinosporum A. Lister, Jour. Bot. 37: 147. 1899.

Plasmodiocarpous, usually curved, strongly compressed laterally, shining, chalky white, dehiscent by a preformed fissure on the upper margin; peridium double, the outer layer smooth, calcareous, the inner membranous, pale purple, iridescent; capillitium dense, the nodes large, white, angular, the internodes short, hyaline; spores purple, marked with conspicuous spines, these sometimes united as ridges, 8 μ in diameter (according to Lister), 11–14 μ in diameter (according to Boedijn); our measurements are intermediate, mostly 10–12 μ , including the spines. Plasmodium unknown.

TYPE LOCALITY: Antigua.

HABITAT: Dead leaves and branches.

DISTRIBUTION: West Indies, Panama; Uruguay; Kenya; India; Indonesia; Philippines.

ILLUSTRATIONS: Jour. Bot. 37, pl. 398, f. 1; Lister, Mycet. ed. 3. pl. 53; Bull. Jard. Bot. Buitenz. III. 16: 362, f. 1; Jour. Ind. Bot. Soc. 34: 89, f. 4, A-G.

Lister gives the spore size as 8μ . All the specimens we have seen have larger spores, but otherwise agree closely with the description. Lister's measurements, as shown in the original figures, apply only to the main body of the spores and disregard the spines. As Lister points out, the affinities of this species are with P. bivalve, from which it differs in the character of the peridium and in the very distinctive spores.

The collection attributed to Kenya was found growing on compost in a Kew greenhouse in which seeds from Kenya had been sown (Kew Bull. 1948: 116).

Physarum famintzinii Rost., Mon. 107. 1874.

Physarum gulielmae Penzig, Myxom. Buitenz. 34. 1898.

Sporangia sessile, clustered or heaped, rugulose, brownish orange or chestnut, globose or reniform, about 0.4 mm in diameter; peridium membranous, bearing clustered deposits of yellowish brown lime granules; capillitium abundant, elastic and expanding, the nodes white or yellow, angular, branching, sometimes forming a pseudocolumella; spores purplish brown, spinulose, 9–12 μ in diameter. Plasmodium yellow or orange.

TYPE LOCALITY: Poland.

HABITAT: Dead wood and plant debris.

DISTRIBUTION: Europe; India; Java; Maryland.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 63; Mycopathologia 28: 267, f.

1, A; 268, f. 2, A.

This species has been collected but once in North America, by E. C. Leonard, in Maryland. The specimen, BPI 15976, was examined and determined by H. C. Gilbert. Our only specimen, from Switzerland, is very old and shattered and inadequate for illustration but the elastic capillitium is very striking.

Singh and Pushpavathi (1966), in reporting the species from India, describe

the nodes as yellow.

Physarum flavicomum Berk., Lond. Jour. Bot. 4: 66. 1845.

Physarum cupripes Berk. & Rav., in Berk. Grevillea 2: 65. 1873.

Physarum berkeleyi Rost., Mon. 105. 1875.

Didymium flavicomum (Berk.) Massee, Mon. 242. 1892.

Sporangia gregarious, stalked, nodding, spherical or lenticular, small, 0.3–0.6 mm in diameter, 1–2 mm tall, dusky yellow or sooty; peridium delicate, often nearly limeless, iridescent, sometimes limy, early deciduous in patches except at the persistent base; stalk cylindrical, usually long, slender, reddish brown, translucent, often darker at base, limeless, fluted, twisted, not hollow, tapering upward from a small, radiating hypothallus; columella none; capillitium dense, persistent, the threads colorless, the nodes yellow, varying from small and angular to elongate, often fusiform, sometimes branching, many of the junctions limeless; spores sooty brown in mass, bright violaceous brown by transmitted light, minutely punctate, 8–10 μ in diameter. Plasmodium yellow, yellowish green or green.

TYPE LOCALITY: New South Wales.

HABITAT: Dead wood.

DISTRIBUTION: New South Wales; New Zealand; India; Southern Rhodesia; Union of South Africa; eastern North America from Maine to Ontario, south to South Carolina and Iowa, fairly common; also Texas, New Mexico, Arizona; Costa Rica; Brazil; Philippines; Sierra Leone.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 32, a,b; Macbr. & Martin, Myxom. pl. 6, f. 111-113.

EXSICCATI: Rav., Fungi Car. 76; Ellis & Ev., N. Am. Fungi 3299.

This species is probably commoner than the available collections indicate. It may easily be passed over, especially when old, as a weathered specimen of *P. viride* or *P. nutans*, with which species it seems to have more in common than with *P. galbeum* and *P. maydis* as suggested in the Lister monograph. See comment under *P. viride*.

This species has now been extensively cultured and its plasmodium is one of three that have been grown in a partially defined liquid medium, the others being those of *P. polycephalum* and *P. rigidum* (Henney & Henney, 1968).

Physarum flavidum (Peck) Peck, Ann. Rep. N. Y. State Mus. 31: 55. 1879.
Didymium flavidum Peck, Ann. Rep. N. Y. State Mus. 28: 54. 1876.
Physarum citrinellum Peck, Ann. Rep. N. Y. State Mus. 31: 57. 1879.
Craterium citrinellum (Peck) A. Lister, Mycet. 74. 1894.

FIG. 256 Plate XXVIII

FIG. 255

Plate XXVIII

Sporangia gregarious or scattered, short-stipitate, or nearly sessile, globose, (0.4-)0.6-0.8(-1) mm in diameter, pale yellow or ochraceous to orange or yellow-brown, usually darker below, slightly rugose; peridium double, the outer layer calcareous, fragile, the inner layer membranous, the lower portion tending to persist as a more or less irregular cup; the stalk usually short, rarely exceeding half the diameter of the sporangium in length, occasionally longer or represented merely by a constricted base, orange-brown, translucent, furrowed, expanded below; capillitium abundant, the nodes large, white, stellate-angular, the internodes delicate, short; spores black in mass, violaceous brown by transmitted light, strongly spinulose, (10-)11-13(-14) μ in diameter. Plasmodium greenish.

TYPE LOCALITY: New York.

HABITAT: Mosses and dead wood.

DISTRIBUTION: Eastern United States and Canada; Oregon; Costa Rica; Europe; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 68; Macbr. & Martin, Myxom. pl. 6, f. 109, 110.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2490; Brândză, Myxom. Roum. II. 1: 8; III. 1: 7(NY); 5,6(IA).

A. Lister, as cited above, transferred P. citrinellum Peck to Craterium but G. Lister, in the two later editions of the Mycetozoa, returned it to Physarum under Peck's name. However, Peck had originally referred it to Didymium as D. flavidum. A still earlier collection was referred to Diderma citrinum (Schum.) Fries, in Ann. Rep. N. Y. State Cab. Nat. Hist. 22: 89. 1869. This was a perfectly natural mistake, and is the source of "D. citrinum Peck" as cited in the Lister monograph. Peck, of course, had no intention of publishing it as new at that time. Hagelstein (1944, p. 30) reported that he examined three specimens of Didymium flavidum including type material and that they agreed with the type of P. citrinellum. Since the epithet flavidum has clear precedence over citrinellum there can be no reason for not using it. Physarum flavidum (Peck) Berl., in Sacc., Syll. 7: 350. 1888, was invalidly published. Berlese was evidently unaware that Peck had previously published the same combination.

The moderately large, bright-colored sporangia make this a conspicuous and attractive species but it seems to be uncommon.

Physarum galbeum Wingate, in Macbr., N. Am. Slime-Moulds 53. 1899.

FIG. 257 Plate XXVIII Sporangia gregarious, stalked, usually erect, globose, golden yellow to chrome, mostly 0.3–0.5 mm in diameter, total height 0.6–1.2 mm; peridium thin, coated with yellow calcareous flakes, sometimes nearly limeless, deciduous in patches; stalk subulate, 1–3 times the diameter of the sporangium, bright orange below, fading to yellow above, translucent, longitudinally furrowed; capillitium a close-meshed, persistent net of yellow threads, the nodes few, small, angular, yellow; spores pale brown in mass, pale yellowish brown by transmitted light, very minutely punctate, with faint clusters of the warts, 7.5–10 μ in diameter. Plasmodium yellow-green.

TYPE LOCALITY: Philadelphia, Pennsylvania.

HABITAT: Dead wood and woody stems.

DISTRIBUTION: Nova Scotia to Minnesota, south to Virginia and Iowa; California, Oregon; PJamaica; England; Ireland; Portugal.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 199, d-f.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2491.

The marks of this species are the small, erect, chrome yellow, globose sporangia borne on limeless stalks, the delicate capillitium with small rounded yellow nodes, and the nearly smooth, pale spores. The smoky color in age is similar to that of *P. flavicomum*.

Our material is scanty; the species appears to be uncommon.

Physarum gilkeyanum H. C. Gilbert, in Peck and Gilbert, Am. Jour. Bot. 19: 133. 1932.

Sporangia sessile, gregarious, globose or broadly obovate on a narrowed base, 0.4–0.8 mm in diameter, 0.7–0.9 mm tall, grayish white; peridium simple, hyaline, usually covered with a thin, reticulately wrinkled coat of lime, irregularly dehiscent; capillitium dense, rigid, fine-meshed, persistent, the nodes few, white, small and rounded at the tip, long, branching, badhamioid at the base; spores dark violaceous brown in mass, violet-brown by transmitted light, coarsely warted, 9–11 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Lebanon, Oregon.

навітат: Leaf mold.

DISTRIBUTION: Oregon, California; ?Ontario; ?India.

ILLUSTRATION: Am. Jour. Bot. 19: pl. 10, f. 1.

Hagelstein (1944) regarded this as a sessile form of *P. mutabile*. This seems unlikely to us. It is hoped that additional collections from the Pacific northwest will be available; meanwhile we propose to retain the species.

A collection from Ontario, R. F. Cain 735, is provisionally referred to this species. It differs from Gilbert's description only in the fact that the peridium is more rugose and that the marked reticulations shown in Gilbert's Fig. I A are less apparent. A collection from California appears to belong here. A specimen from India, referred here by Indira (1966), is described and illustrated as having the lime in patches forming a broken reticulation and with the peridium black inside the base.

Physarum globuliferum (Bull.) Pers., Syn. Fung. 175. 1801.

Sphaerocarpus globulifer Bull., Hist. Champ. Fr. 134. 1791.

Stemonitis globulifera (Bull.) J. F. Gmel., Syst. Nat. 2: 1469. 1791.

Trichia globulifera (Bull.) DC., Fl. Fr. 2: 253. 1805.

Diderma globuliferum (Bull.) Fries, Syst. Myc. 3: 100. 1829.

Physarum petersii var. farlowii Rost., Mon. App. 6. 1876.

Didymium subroseum Peck, Ann. Rep. N. Y. State Mus. 28: 54. 1876.

Physarum albicans Peck, Ann. Rep. N. Y. State Mus. 30: 50. 1878.

Physarum columbinum Macbr., Bull. Nat. Hist. Univ. Iowa 2: 384. 1893.

Not P. columbinum Pers., 1795, nor P. columbinum Sommerf. 1826.

Cytidium globuliferum (Bull.) Morgan, Jour. Cinc. Soc. Nat. Hist. 19: 10. 1896.

Physarum relatum Morgan, Jour. Cinc. Soc. Nat. Hist. 19: 26. 1896.

Sporangia stipitate, gregarious, often in extensive colonies, sometimes united in clusters, globose or slightly depressed, 0.4–0.7 mm in diameter, 0.6–1.5 mm tall, white, pale ochraceous or pinkish; peridium membranous, bearing crustose patches of lime granules; stipe subulate, slender, smooth or wrinkled, brittle, calcareous, usually white, sometimes ochraceous or dull red, usually ex-

FIG. 258
Plate XXVIII

ceeding the sporangium; columella short, conic, or blunt, rarely lacking; hypothallus scanty, inconspicuous; capillitium dense, delicate, persistent, the nodes small, rounded, white, many of the junctions limeless; spores dark grayish brown in mass, violet by transmitted light, minutely warted, the warts in indistinct clusters, $7-9~\mu$ in diameter. Plasmodium yellow or white.

TYPE LOCALITY: France.

HABITAT: Dead wood.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Bull., Herb. Fr. pl. 484, f. 3; Lister, Mycet. ed. 3, pl. 16;
Macbr. & Martin, Myxom. pl. 5, f. 76-78; Hattori, Myxom. Nasu pl. 17, f. 3; Nat. Geogr. Mag. 49(4): pl. 4.

EXSICCATI: Ellis, N. Am. Fungi 1120; Jaap, Myxom. Exs. 42; Thaxter, Rel. Farl. 414; Brândză, Myxom. Roum. II. 1: 18; 93, 94(NY).

The characters of the stalks vary with the amount of lime included. When very limy, they tend to be smooth, white and brittle; when little lime is present, they are furrowed and tend to be ochraceous and often reddish brown at base. The species is fairly comon and often forms extensive and conspicuous fruitings. The delicate capillitium is very dense and retains the shape of the sporangium after the peridium is shed.

Didymium longipes Massee, Mon. 237. 1892, cited in the Lister monograph as a possible synonym, may well be an example of this species with an unusually long stalk. A. Lister, Mycet. 103. 1894, recognized the species but reported there was no specimen at Kew, as Massee had stated. Physarum delicatissimum Speg., Ann. Mus. Nac. Buenos Aires 6: 199. 1899, is also cited there as a possible synonym. See also footnote to P. bilgramii.

Physarum gyrosum Rost., Mon. 111. 1874.

FIG. 259
Plate XXVIII

Physarum cerebrinum Massee, Mon. 306. 1892.

Fuligo gyrosa (Rost.) Jahn, Ber. Deuts. Bot. Ges. 20: 272. 1902.

Plasmodiocarps white or gray to brownish or reddish drab, forming a close net or rosette-like tufts sometimes so closely massed as to approach an aethalium, varying to sporangium-like fruitings attached to the substratum by a weak, yellow or red, stalk-like strand of the hypothallus, the plasmodiocarps higher than broad, 0.2–0.4 mm wide and up to 1 mm or more high, the clumps usually 2–3 mm in diameter, frequently much larger, often closely aggregated into a pseudoaethalium; peridium single, membranous, with scattered, white or reddish lime deposits; capillitium a dense, elastic, net-work of delicate, hyaline threads, with numerous large, spike-like, transverse, white nodes and smaller fusiform nodes; spores dark brown in mass, pale violaceous brown by transmitted light, minutely spinulose, 7–10 μ in diameter. Plasmodium white, changing to yellow upon exposure to light.

TYPE LOCALITY: Germany.

HABITAT: Soil, surface debris, and often encrusting leaves of living plants. DISTRIBUTION: Western Europe, there mostly in greenhouses; Nigeria; Madagascar; Ceylon; China; Japan; Philippines; Australia; Hawaii; Brazil; not uncommon in eastern United States from New York to Kansas and south to Florida and Louisiana.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 52; Macbr. & Martin, Myxom. pl.

6, f. 123, 124; Hattori, Myxom. Nasu pl. 16, f. 1; Hagelst., Mycet. N. Am. pl. 8, f. 3.

EXSICCATI: Ellis, N. Am. Fungi 1596.

Before Rostafinski, this species had been confused with Fuligo muscorum and Physarum bivalve, and the synonyms he cites are mainly referable to the former. Recent collectors have also confused it with Physarum polycephalum. It is perhaps closer to the last-named than to the others, but its strongly plasmodiocarpous habit, the very large spike-like white nodes and the elastic capillitium mark it clearly. When lime is abundant, the peridium may appear to be double, but the lime flakes away rather quickly and in most collections the wall would be regarded as single.

In the eastern United States it has on various occasions been found fruiting in great abundance on the stems and foliage of garden or crop plants, particularly sweet potatoes. It has been listed as a parasite, but the actual harm done is slight.

Physarum javanicum Racib., Hedwigia 37: 53. 1898.

Physarella javanica (Racib.) Torrend, Broteria 7: 114. 1908.

Physarum discoidale Macbride, N. Am. Slime-Moulds ed. 2. 74. 1922.

Sporangia stalked, gregarious, obconic or turbinate, umbilicate above, erect or nodding, 0.4–1 mm in diameter, 2–4 mm tall; peridium thin, white, thickly encrusted with small, irregular calcareous granules, the upper part dehiscent at maturity; stalk slender, furrowed, usually long, attenuate above, grayish white, darker below, arising from a small hypothallus; capillitium dense, rigid, composed of colorless, thin, often spindle-shaped tubes connecting the numerous elongated or triangular, white nodes; spores dark in mass, purplish brown by transmitted light, globose, nearly smooth, 9–10 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Buitenzorg, Java.

HABITAT: Dead wood, twigs, and grass.

DISTRIBUTION: Java; South and East Africa; Florida; California; Costa Rica; Jamaica; Trinidad; Colombia; England.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 197; Brittonia 16: 341, f. 3, 4.

G. Lister, Mycet. ed. 3, suggested that *P. discoidale* might be the same as *P. javanicum*. Hagelstein (1944) was sure that it was a short-stemmed form of the latter species. Martin (1949) was uncertain. Reexamination of the scanty type material confirms Hagelstein's opinion and also has shown on the bottom of the box, where it was overlooked, a pencil note in Macbride's hand "= *P. javanicum* Racib. #35 in Lis. 2nd ed." indicating that he had come to the same conclusion before the 3rd edition of Lister was published.

The species seems not uncommon in the tropics. It is really quite unlike either *P. pezizoideum* or *P. viride*, with which it has been compared. Our figures are drawn from the type of *P. discoidale*. Farr (1964) confirms the distinctness of *P. javanicum*.

Physarum laevisporum Agnihothrudu, Sydowia 16: 121. 1963.

Plasmodiocarpous, the plasmodiocarps terete, usually short, but crowded into a discontinuous reticulate pattern, often broken into short sporangium-like sections, white or dingy, the segments up to 10 mm long and about 0.3–0.5 mm in diameter; dehiscence irregular above; peridium double, the outer layer smooth or somewhat areolate, composed of densely compacted lime granules

FIG. 260 Plate XXIX up to 2 μ in diameter, separating into distinct lobes; inner peridium thin, translucent, purplish, iridescent, closely united to outer peridium; capillitium dense, the nodes large, white or pallid, angular, up to 100 μ in diameter, connected by slender, hyaline tubules; spores black in mass, dark purplish brown by transmitted light, globose, smooth, 7–8 μ in diameter. Plasmodium grayish black.

TYPE LOCALITY: Nazira, Assam. HABITAT: Dead litter under tea.

DISTRIBUTION: Known only from the type collection. ILLUSTRATIONS: Sydowia 16: 121, f. 1; 124, f. 2.

Known to us only from the original description, which indicates a very distinctive species. Additional collections are needed to confirm this judgment.

FIG. 261 Plate XXIX Physarum lateritium (Berk. & Rav.) Morgan, Jour. Cinc. Soc. Nat. Hist. 19: 23. 1896.

Didymium lateritium Berk. & Rav., in Berk., Grevillea 2: 65. 1873.

Didymium croceo-flavum Berk. & Br., Jour. Linn. Soc. 14: 84. 1873.

Physarum ditmari var. croceo-flavum (Berk. & Br.) Rost., Mon. App. 9. 1876. Physarum ditmari var. lateritium (Berk. & Rav.) Rost., Mon. App. 9. 1876. Physarum inaequale Peck, Ann. Rep. N. Y. State Mus. 31: 40. 1879.

Sporangiate, sessile, globose or subglobose, 0.3–0.7 mm in diameter, or occasionally forming short plasmodiocarps, gregarious or clustered, yellowish red, orange, or scarlet, sometimes fading; peridium thin, somewhat rugulose, dotted with minute scarlet scales; capillitium delicate, usually dense, the nodes rounded, pallid to yellow, often with deep yellow or red centers, connected by a network of hyaline or yellow threads, the lime often of large, subcrystalline granules, many of the nodes limeless, consisting merely of membranous expansions; spores violet-brown in mass, clear bright violet by transmitted light, minutely warted, 7–9 μ in diameter. Plasmodium orange-yellow.

TYPE LOCALITY: South Carolina.

HABITAT: Dead wood and leaves.

DISTRIBUTION: Nova Scotia to Iowa and Panama; South America; Europe; Asia; Hawaii.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 60; Hattori, Myxom. Nasu. pl. 19, f. 5; Nat. Geogr. Mag. 49(4): pl. 8.

This species is closest to *P. rubiginosum*, from which it differs in its smaller size, paler colors, more delicate peridium, smaller and more rounded nodes, and smaller spores. As in that species, the curious darker centers of the nodes are found in most collections. The nodes are filled with large, angular, sometimes subcrystalline granules.

The Lister monograph lists *P. braunianum* as a synonym. As noted under that species, the specimens we have seen seem to belong to a distinct species. If the type specimen of *P. braunianum* is an undeveloped form of *P. lateritium*, as Jahn, cited by Lister, concluded, then our specimens must have a new name.

Physarum leucophaeum Fries, Symb. Gast. 24. 1818.

FIG. 262 Plate XXIX Didymium terrestre Fries, in Weinm., Fl. Ross. 5: 74. 1836.

Tilmadoche leucophaeum (Fries) Fries, Summa Veg. Scand. 454. 1849.

Physarum granulatum Balf. f., in Cooke, Grevillea 10: 115. 1882.

Physarum imitans Racib., Rozp., Akad. Umiej. 12: 73. 1884.

Physarum readeri Massee, Mon. 282. 1892.

Tilmadoche nephroidea Čelak. f., Arch. Nat. Land. Böhmen 7(5): 69. 1893. Physarum nutans var. leucophaeum A. Lister, Mycet. 51. 1894.

Sporangia gregarious or scattered, subglobose to depressed, stipitate, varying to sessile or rarely subplasmodiocarpous, bluish ashen to white, darker below, 0.4–0.8 mm in diameter, the total height 0.8–1.5 mm; peridium thin, membranous, iridescent, flecked with lime or sometimes rather strongly calcareous, convex or plane below, rarely umbilicate, usually with a dark basal disk or shallow cup; dehiscence irregular; stalk usually short, fuscous to reddish brown, often powdered with white, often spirally twisted, arising from a dark, more or less netted hypothallus; capillitium delicate, dense, the nodes numerous, white, mostly rounded but varying to large, angular or branching and then fewer; spores black in mass, yellow-brown by transmitted light, minutely roughened, 9–11 μ in diameter. Plasmodium probably white.

TYPE LOCALITY: Sweden.

HABITAT: Dead wood and leaves.

DISTRIBUTION: Widely distributed in Europe; in North America from Maine, Ontario and Washington south to Mexico; Jamaica; Chile; Sierra Leone; Pakistan; India; New Zealand.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 38 (as ssp.); Macbr. & Martin, Myxom. pl. 5, f. 98, 99.

EXSICCATI: Ellis. & Ev., N. Am. Fungi 2693; Zahlbr., Krypt. 938.

In the three editions of the Lister monograph and in Hagelstein (1944), this is listed as a variety of *P. nutans*. We have many specimens which have been referred to *P. leucophaeum* which do seem to represent short-stemmed fruitings of that species, but they are to be distinguished from what we regard as *P. leucophaeum* by the more nodding habit, and the lenticular and umbilicate sporangia which tend to dehisce in lobes, and the quite different capillitium. *P. leucophaeum* is usually erect or only slightly nodding, the sporangium is globose or oblate, with a thickened base, the peridium is sometimes more limy and the capillitium is delicate but scarcely dichotomous, often with a good proportion of large, angular nodes interspersed with smaller rounded ones, and many nodeless junctions. Hagelstein (1944, p. 59) says that certain phases of *P. crateriforme* resemble what he calls the variety, but gives no details.

Physarum leucopus Link, Ges. Nat. Freunde Berlin Mag. 3: 27. 1809.Physarum bullatum Link, Ges. Nat. Freunde Berlin Mag. 3: 27. 1809.Didymium leucopus (Link) Fries, Syst. Myc. 3: 121. 1829.

FIG. 263
Plate XXIX

Sporangia gregarious, stipitate, globose, white, 0.4–0.5 mm in diameter; peridium calcareous, the lime in small, frosty particles, suggesting Didymium; stalk white, calcareous, sulcate, brittle, tapering upward, about equal to the sporangium or sometimes very short; columella usually none, sometimes present as a short conical protuberance; capillitium rather lax, the nodes large, angular, white, connected by long, hyaline threads, sometimes massed in center forming a pseudocolumella; spores black in mass, pale violet-brown by transmitted light, distinctly warted, 8–10 μ in diameter. Plasmodium white, often tinted with blue, green, or yellow.

TYPE LOCALITY: Germany.

HABITAT: Dead leaves and wood. DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 15.

EXSICCATI: Jaap, Myxom. Exs. 181.

Before the peridium breaks, this species is remarkably similar in appearance to *Didymium squamulosum*. When the spore mass is exposed, the conspicuous white nodes make its physaroid nature apparent. In addition, the lime is not crystalline, the columella, when present, is very small, and the spores are smaller and paler.

The species is probably commoner than the collections suggest.

Physarum listeri Macbr., in Macbr. & Martin, Myxom. 62. 1934.

Physarum luteoalbum A. & G. Lister, Jour. Bot. 42: 130. 1904. Not P. luteoalbum Schum. 1803.

Diderma luteoalbum (A. & G. Lister) Buchet, Bull. Soc. Myc. Fr. 56: 127. [1940] 1941.

Sporangia gregarious, stipitate, rarely sessile, subglobose or short-allantoid, bright yellow to dull orange or olivaceous, or dark and iridescent in limeless phases, mostly 0.8–1 mm broad; peridium double, the outer portion smooth or reticulately rugulose, the lime deposits dense to scanty or nearly lacking, the inner portion dark, shining olivaceous, dehiscent except for a persistent collar at the base; stalk stout, calcareous, smooth, with a membranous outer wall often separated above, and sometimes with large crystalline nodules within, 0.5–1 mm high, cylindric or expanding upward, white below, changing to yellowish or orange above, rising from a netted, strand-like hypothallus; columella large, subglobose or depressed-clavate; capillitium of rigid, slender or coarse, radiating yellow threads, branching and anastomosing, the nodes few, yellow, linear or fusiform, or occasionally large and rounded; spores black in mass, dark purple-brown by transmitted light, coarsely and somewhat irregularly spiny, 10–13 μ in diameter. Plasmodium orange.

TYPE LOCALITY: Ventimiglia, Italy. HABITAT: Dead leaves and wood.

DISTRIBUTION: Europe, widely scattered but not common. In North America, Quebec to Ontario, south to North Carolina and Colorado, even less common; West Pakistan; India.

ILLUSTRATIONS: Jour. Bot. 42: pl. 459, f. 2; Lister, Mycet. ed. 3. pl. 24; Macbr. & Martin, Myxom. pl. 5, f. 74. 75.

EXSICCATI: Jaap, Myxom. Exs. 84.

A very striking and distinctive species. In the Jaap specimen, which we illustrate, the center of the stalk contains large subcrystalline aggregates much like those illustrated by von Höhnel, in Sitz.-ber. Akad. Wien 118: 162, f. 34, for his Diachaeella bulbillosa (=Diachae bulbillosa of the present treatment). Hagelstein (1944, p. 36) notes its resemblance to a Diderma. Nodes are scanty or lacking in some of the material examined, and appear to be replaced by clusters of rather large amorphous lime granules which occur free amongst the spores and are often aggregated in nodular masses on the capillitial strands. It may be that this species deserves to be ranked in a genus of its own, close to Physarina, but our material is too old and scanty to justify recognizing it as such at present.

The var. aureum Ronn, 1911, refers only to a color phase, and is of no significance. Krzemieniewska (1960, p. 96) refers this species to *Physarum schroeteri* Rost., which the Lister monograph cites as a possible synonym of *P. citrinum*.

FIG. 264 Plate XXIX Rostafinski's description, as translated in Saccardo, Syll. 7: 339. 1888, suggests that Krzemieniewska may be correct, in which case Rostafinski's combination is valid.

Physarum luteolum Peck, Ann. Rep. N. Y. State Mus. 30: 50. 1878.

Physarum virescens var. nitens A. Lister, Mycet. 59. 1894.

Sporangia gregarious or clustered, but not heaped, subglobose, sessile, often on a restricted base, 0.4–0.8 mm in diameter, rugulose or nearly smooth, bright chrome-yellow; peridium single, membranous, with included yellow lime granules; capillitium a network of hyaline threads bearing numerous small, yellow; rounded or angular nodes; spores brown in mass, pale lilaceous by transmitted light, minutely spinulose, 8.5–10 μ in diameter. Plasmodium unknown, probably yellow.

TYPE LOCALITY: New York.

HABITAT: Dead leaves.

DISTRIBUTION: Maine to Ontario, south to Pennsylvania and Iowa. Reported from Great Britain, Ireland and Czechoslovakia.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 62, a-c.

A. Lister (1894) regarded this as a variety of *P. virescens*, and this is repeated in the later editions of the Lister monograph. Sturgis (1900) reported that the type has been so crushed as to be unrecognizable, but points out some details which make Lister's decision improbable. He recommended that the name be discarded. Hagelstein (1944) used Peck's name for a species which is widespread but apparently uncommon in Canada and the United States and which he believed agreed with Peck's description. He notes that this species differs from *P. virescens* var. *nitens* Lister in that it is not heaped, is brighter in color and larger than that variety. He adds that it is more like *P. cinereum* except for the yellow color. The North American species must have a name and for the present it seems wise to follow Hagelstein in using Peck's name for it. To what extent the European reports apply to this species is uncertain.

Physarum megalosporum Macbr., N. Am. Slime-Moulds ed. 2. 63. 1922.

Physarum melanospermum Sturgis, Mycologia 9: 323. 1917. Not P. melanospermum Pers. 1794.

Sporangia gregarious, short-stipitate or sessile, depressed-annulate or umbilicate above, rugulose, white above or rarely touched with rose, darker below, 0.4–0.7 mm in diameter; stalk, when present, thick, black, rough; hypothallus black, inconspicuous; columella none; capillitium strongly calcareous, the nodes white, irregular, sometimes massed toward the center as a pseudocolumella, the connecting threads short, hyaline; spores black in mass, dark purplish brown by transmitted light, with a paler area of dehiscence, minutely and closely verruculose, 12-14(-15) μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Colorado.

HABITAT: Dead leaves and wood.

DISTRIBUTION: Iowa, Kansas, Colorado.

ILLUSTRATIONS: Mycologia 9: pl. 14, f. 1–3; Macbr., N. Am. Slime-Moulds ed. 2. pl. 16, f. 7, 7a; Lister, Mycet. ed. 3. pl. 201; Hagelst., Mycet. N. Am., pl. 2, f. 1–3.

FIG. 265 Plate XXIX

FIG. 266 Plate XXIX The nearly sessile, usually somewhat annulate white sporangia and the large dark spores with a conspicuous paler area are the marks of this species. It is said to be locally abundant in Colorado and its occurrence in two states to the east suggests that it may have been overlooked elsewhere.

Physarum melleum (Berk. & Br.) Massee, Mon. 278. 1892.

FIG. 267
Plate XXIX

Didymium melleum Berk. & Br., Jour. Linn. Soc. 14: 83. 1873.

Didymium chrysopeplum Berk. & Curt., in Berk., Grevillea 2: 53. 1873.

Physarum schumacheri var. melleum (Berk. & Br.) Rost., Mon. App. 7. 1876. Physarum kalchbrenneri Massee, Mon. 297. 1892.

Physarum rubropunctatum Pat., Bull. Soc. Myc. Fr. 9: 143. 1893.

Cytidium melleum (Berk. & Br.) Morgan, Jour. Cinc. Soc. Nat. Hist. 19: 11. 1896.

Sporangia gregarious, stipitate, rarely sessile, globose or somewhat flattened below, 0.4–0.5 mm in diameter, usually yellow to dull orange, but varying from yellowish gray or honey yellow to bright orange-red or reddish brown; peridium rugose, encrusted with lime, persistent below; stalk cylindric or tapering upward, stout, opaque, typically white, sometimes ochraceous or tawny, furrowed, calcareous, short, about equal to the width of the sporangium; columella small, conic, white or yellowish, rarely orange; capillitium abundant, the nodes large, angular, white or less commonly yellow or orange; hypothallus white or colorless; spores dark in mass, pale violet-brown by transmitted light, minutely warted, 7.5–10 μ in diameter. Plasmodium yellow or olive-green.

TYPE LOCALITY: Peradeniya, Ceylon.

HABITAT: Dead wood and leaves.

DISTRIBUTION: Cosmopolitan. Common in eastern and southern United States and in the tropics of both hemispheres; elsewhere apparently scattered and uncommon.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 23; Macbr. & Martin, Myxom. pl. 4, f. 68–71; Hattori, Myxom. Nasu pl. 16, f. 5.

Despite the color range from gray, with only a suggestion of yellow, to brownish red, this is a rather well-marked species, characterized by the neat globose sporangia surmounting an erect, limy, usually white stalk, the persistent capillitium with angular, white or tinted nodes, and the pale, distinctly violaceous spores. The description of *Physarum rubropunctatum*, cited in the Lister monograph as a possible synonym, can scarcely apply to any other species. *Physarum tucumanense* Speg., Rev. Agr. Vet. La Plata 1896: 237. 1897?, also cited, is no more than a name to us. *Physarum perfectum* M. E. Peck, cited by Hagelstein (1944) as a synonym, is here retained as distinct.

Physarum mennegae Nann.-Brem., Acta Bot. Neerl. 10: 54. 1961.

FIG. 268 Plate XXIX Sporangia gregarious, stipitate, globose, brown, 0.3–0.5 mm in diameter, total height up to 1 mm; stalk about equal to diameter of sporangium or slightly greater, brittle, pale yellowish, translucent, occasionally penetrating sporangium as a short columella, expanding at base to a circular, hyaline hypothallus; peridium thin, hyaline, nearly limeless, irregularly dehiscent; capillitium rather sparse, the nodes white, irregular, often branching; spores dark brown in mass, yellowish brown by transmitted light, subglobose, minutely verrucose, the warts clustered, 7–8 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Surinam. HABITAT: Dead leaves.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATION: Acta Bot. Neerl. 10: 55, f. 1.

Differing from *P. penetrale* in its globose rather than prolate sporangia, the shorter and thicker columella, the shorter and yellow rather than reddish stalk, the white, often irregular, nodes and the larger, more brownish, spores. These differences are not great, but they, and the aspect of the sporangia, suggest that the species is sufficiently distinct from *P. penetrale* to be recognized.

Our description is modified from the original on the basis of a portion of the

type kindly supplied by Mme. Nannenga-Bremekamp.

Physarum mortonii Macbr., N. Am. Slime-Moulds ed. 2. 58. 1922.

Physarum contextum var. mortoni (Macbr.) G. Lister, in Lister, Mycet. ed. 3. 60. 1925.

FIG. 269 Plate XXIX

Sporangiate, or rarely plasmodiocarpous, clustered, sessile, often on a contracted base, then sometimes substipitate or on an extended repent stalk, 0.5–1 mm in diameter, bright ochraceous to pallid; peridium double, the outer layer rough, calcareous, breaking up into coarse, irregular fragments, the inner layer membranous, dark but bearing calcareous flakes and granules and colored by them, both layers persisting as a cup below; capillitium lax, the nodes large, white, angular, often aggregated at the center as a pseudocolumella; true columella none; spores black in mass, dark purplish brown by transmitted light, coarsely spinose, 11–13 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Oregon.

HABITAT: Dead leaves and bark.

DISTRIBUTION: Washington, Oregon, California.

ILLUSTRATIONS: Macbr. & Martin, Myxom. pl. 5, f. 72, 73.

As noted above, Lister reduced this to a variety of *P. contextum*. Hagelstein (1944) says it is "unworthy of even varietal rank." With this we cannot agree. The sporangia, not rarely stalked and without the lid so often characterizing *P. contextum*, the large size, the well developed plasmodiocarps in some collections and the dark, spiny spores make it worthy of recognition, particularly as such specimens have appeared over an extensive range in the Pacific area. Our illustrations are based on an excellent specimen from M. E. Peck, Oregon, labelled in Macbride's hand and undoubtedly one of the specimens which Macbride had before him when he described the species. It has been designated as the type.

Physarum mucosum Nann.-Brem., Med. Bot. Mus. Herb. Utrecht 150: 782. 1958.

Sporangia sessile, often narrowed at the base, acetabuliform, subregular and 0.4–0.6 mm in diameter, as well as in height, or developed into curved and occasionally even annular plasmodiocarps and then the largest diameter up to 2.5 mm, flattened at the top and there surrounded by a protruding irregular and thin margin, congested in small colonies and therefore angular by mutual compression, pale yellow or ochraceous; hypothallus inconspicuous; peridium double, the outer layer thick and encrusted with lime, becoming slimy when moistened, finally crumbling away from the membranous inner layer; in dehiscence the part of the outer layer within the protruding margin

is cracked and crumbles away, the inner layer is fractured later; after the dispersal of the spores and the disappearance of the capillitium the cup-shaped base of the peridium persisting for a time; capillitium consisting of fine threads containing numerous white, angular and forked lime knots, sometimes almost badhamioid, and in the center of the sporangium aggregated into a thick, white and rugose pseudocolumella which is free from the base of the sporangium; spores black in mass, dark violet-brown by transmitted light, globose, $12-13~\mu$ in diameter, with a thin wall (less than half as thick as that of P. contextum), distinctly and irregularly spinulose. Plasmodium yellow.

TYPE LOCALITY: Doorwerth, Holland. HABITAT: Dead twigs and leaves.

DISTRIBUTION: Netherlands, Sweden, Scotland.

ILLUSTRATION: Med. Bot. Mus. Herb. Utrecht 150: 782. f. 2.

This species differs from *P. contextum* in the thin peridial margin, the darker, more strongly-warted spores with the warts arranged in a subreticulate pattern and, most importantly, in the mucose outer peridium. The prominent pseudo-columella, stressed by the author, is sometimes present in *P. contextum*.

Physarum murinum A. Lister, Mycet. 41. 1894.

Cytidium ravenelii Morgan, Jour. Cinc. Soc. Nat. Hist. 19: 10. 1896.

Physarum ravenelii (Morgan) Macbr., N. Am. Slime-Moulds 48. 1899. Not P. ravenelii (Berk. & Curt.) Massee, 1892.

Physarum heterosporum Widder, Verh. Zool.-Bot. Ges. Wien 73: 159. 1923.

Sporangia stipitate, gregarious, globose, about 0.5 mm in diameter, occasionally sessile or plasmodiocarpous, ashy brown or drab, rarely yellow-brown, sometimes fading to dingy white; peridium membranous, encrusted with a rugose layer of lime; stalk cylindric, pale brown, furrowed, calcareous, brittle, usually equalling or exceeding the sporangium; hypothallus inconspicuous; columella short, hemispheric or bluntly conic; capillitium dense, hyaline, brownish or orange-brown, the nodes rounded or angular, usually small, brownish or orange; spores brown in mass, lilaceous brown by transmitted light, minutely warted, the warts somewhat clustered, 8–10 μ in diameter. Plasmodium pale yellow.

TYPE LOCALITY: Moffat, Scotland. HABITAT: Dead wood and leaves.

DISTRIBUTION: Western Europe, eastern United States to Missouri and Kansas; Washington; Costa Rica.

ILLUSTRATION: Lister, Mycet. ed. 3. pl. 18.

A trim, neat species closely related to *P. globuliferum*, from which it is distinguished not only by the external color, but by the persistently brown capillitium originating in stout brown branches emerging from the columella, bearing numerous brown nodes, and by the brown spores. The collection on which it was originally based was referred by A. Lister (Jour. Bot. 29: 259. 1891) to *P. braunianum* de Bary. This is the source of the name "*P. braunianum* A. Lister," frequently cited but never validly published. The plasmodiocarpous phase must be very rare; the nearest approach to it in our material is a specimen from Iowa in which up to a dozen sporangial heads are massed together in stalked pseudoaethalia.

The synonymy is confusing. Morgan based his Cytidium ravenelii on Didymium

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FIG. 270

Plate XXX

ravenelii Berk. & Curt., but according to A. Lister, Mycet. 41. 1894, that is P. pulcherripes of the present treatment. Morgan also cited P. simile Rost., 1876, now regarded as perhaps best included in P. nucleatum, as a synonym of C. ravenelii.

Lister's plate 18, in other respects admirable, is much too purple. There is considerable variation in the color of the peridium but nothing approaching the color there shown. The brown nodes are more constant and are particularly useful in separating the paler forms from *P. globuliferum*. It has been suggested that it would be proper to merge *P. murinum* with that species or to reduce it to varietal status, but its constancy over a very extensive range seems to rule this out.

Physarum mutabile (Rost.) G. Lister, in Lister, Mycet. ed. 2. 53. 1911.

Crateriachea mutabilis Rost., Mon. 126. 1874.

Didymium neapolitanum Ces., in Rab.-Wint., Fungi Eur. 2675. 1881.

Physarum crateriachea A. Lister, Guide Brit. Mycet. 20. 1895.

Sporangia subglobose to erect-ovoid or cylindric, 0.3–0.6 mm in diameter, usually stalked, but sometimes sessile or forming long plasmodiocarps, white, becoming yellowish gray with weathering; peridium thin, wrinkled, bearing uniform, sometimes squamulose lime deposits; stalks, when present, yellow or brownish, usually enclosing lime, especially at the base, sometimes limeless, rising from a white or ochraceous hypothallus; capillitium intricate, persistent, somewhat elastic, the nodes white, varying in size, in the stalked forms tending to be massed at the center as an often cylindrical pseudocolumella, sometimes with large crystalline nodules in the center; spores black in mass, purplish brown by transmitted light, spinulose, 8–10 μ in diameter. Plasmodium watery gray.

TYPE LOCALITY: Germany.

HABITAT: Leaves and herbaceous stems.

DISTRIBUTION: Western Europe; Cameroon; South Africa; Ceylon; Ontario;

California.

ILLUSTRATION: Lister, Mycet. ed. 3. pl. 44.

EXSICCATI: Rab.-Wint., Fungi Eur. 2675, 2969 (as Didymium squamulosum); Brândză, Myxom. Roum. I. 1: 4; II. 1: 10; III. 1: 9(NY).

A rare species, possibly collected more frequently than the records indicate, but confused with others. The pseudocolumella, when cylindrical, is very prominent and the internodes tend to be flattened as shown in Lister's figure. Our material is not adequate to permit decision as to whether the crystalline nodules in the pseudocolumella are constant features.

Physarum nasuense Emoto, Bot. Mag. Tokyo 45: 551. 1931.

Fructifications sessile, scarlet, scattered or clustered, sporangiate or sometimes elongated into short, sometimes branched, plasmodiocarps, 0.35–0.5 mm in width; peridium double, the outer layer scarlet, cartilaginous, the inner layer somewhat limy, pale yellow, translucent, closely united to the outer layer, dehiscence lobate; neither columella nor hypothallus present; capillitium of slender, pale yellow threads bearing rather large, irregular pale yellow nodes with deep orange-red centers; spores globose, violet-brown, distinctly warted, 8–10 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Nasu, Japan.

FIG. 271 Plate XXX HABITAT: On moss on bark of living *Cornus controversa* and on fallen leaves of the same.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATIONS: Bot. Mag. Tokyo **45**, pl. 7, f. 1–4; Hattori, Myxom. Nasu, pl. 19, f. 6, p. 218, 2 figs.

Differing from *P. lateritium*, which also has nodes with orange or red centers, and from *P. rubiginosum*, which may have them, in the brighter color, the lobate dehiscence and the double peridium, and from *P. braunianum* in color of the peridium and of the capillitial threads and nodes.

Although known only from a single collection, the description is clear and that, and the illustrations cited, give a picture of a distinctive and readily recognized species.

Physarum newtonii Macbr., Bull. Nat. Hist. Univ. Iowa 2: 390. 1893.

Sporangia gregarious, stalked or sessile, globose, or flattened and umbilicate above, 0.5–0.7 mm in diameter, bright rose-purple; peridium membranous, smooth, with innate lime granules; stalk, when present, short or sometimes exceeding diameter of sporangium, concolorous or darker; hypothallus small, radiating, dark purplish; columella none; capillitium abundant, purple, the nodes large, angular; spores purplish black in mass, dark purplish red by transmitted light, thick-walled, irregularly warted, 8–10 μ in diameter. Plasmodium dark violet (Emoto, 1928).

TYPE LOCALITY: Pike's Peak, Colorado.

навітат: Dead wood.

DISTRIBUTION: Colorado; Oregon; Japan.

ILLUSTRATIONS: Bull. Nat. Hist. Univ. Iowa 2: pl. 11, f. 1; Lister, Mycet. ed. 3. pl. 28; Hattori, Myxom. Nasu, pl. 19, f. 4.

The brilliant purple color, the single peridium, the large purple nodes, and the dark purplish red spores are the characteristics of this rare species. Hagelstein (1944, p. 43) noted differences between the type collection as described, and the Japanese material he examined.

Our only specimen, probably part of the type, is now too scanty for illustration. The illustrations cited are excellent.

FIG. 272 Plate XXX Physarum nicaraguense Macbr., Bull. Nat. Hist. Univ. Iowa 2: 382. 1893.

Physarum reniforme (Massee) G. Lister, in Lister, Mycet. ed. 2. 72. 1911, in part. (Name based on *Tilmadoche reniformis* Massee, 1892.)

Sporangia gregarious, stalked, multilobate or compound-contorted, obconic below, grayish white, ribbed with calcareous thickenings, the individual sporangia 0.3–0.6 mm in diameter, the clusters up to 2 mm across, their total height 0.8–1.5 mm; stalk short, fluted, up to half the total height, black at base, often frosted above with lime; hypothallus black, reticulate; capillitium dense, white, the nodes large, angular, massed at the center, sometimes forming a pseudocolumella, the connecting threads short, hyaline; spores black in mass, dark violaceous brown by transmitted light, closely and distinctly warted, 9–11(–12) μ in diameter. Plasmodium white to pale yellow.

TYPE LOCALITY: Ometepe, Nicaragua.

HABITAT: Dead wood.

DISTRIBUTION: Nicaragua, Costa Rica; West Indies; Sierra Leone; Ceylon; India; Japan; Philippines; Caroline Islands.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 41 (as P. reniforme); Jour. Ind. Bot. Soc. 33: 184. f. 2, A-F.

In the Lister and Hagelstein monographs, this is regarded as a phase of *P. reniforme* (Massee) G. Lister. Massee's original description of *Tilmadoche reniformis* (1892, p. 337) emphasizes the reniform sporangia and the very large, dark, strongly spinose spores. These characters do not fit *P. nicaraguense*. A. Lister's statement (1894, p. 54) that *Didymium echinospora* Massee, Mon. 239. 1892, is the same species, does not clarify the confusion. As noted under *P. compressum*, *P. reniforme* (Massee) G. Lister appears to be at least in part a phase of that species. Massee's description suggests it, but apparently his type was a mixture of two species. See Petch, Ann. Bot. Gard. Peradeniya 4: 344. 1910, and Macbride, N. Am. Slime-Moulds ed. 2. 83. 1922, for fuller comment. It is possible, however, that some collections now assigned to *P. compressum* should be segregated as *P. reniforme* in Massee's sense. Massee's description does not apply to *P. nicaraguense*. Hagelstein (Mycet. N. Am. 63. 1944) reported *P. reniforme* from Pennsylvania, Costa Rica, and Puerto Rico. The Puerto Rican specimens appear to represent *P. nicaraguense*.

P. nicaraguense appears to be fairly common in the American tropics, and its appearance in characteristic form in south and east Asia and in Oceanica clearly demonstrates its right to specific autonomy. In addition, cultural studies by Solis (1962) leave no doubt that the characters on which the species is based are retained under different environmental conditions.

Physarum notabile Macbr., N. Am. Slime-Moulds ed. 2. 80. 1922.

Didymium connatum Peck, Ann. Rep. N. Y. State Mus. 26: 74. 1874.

Physarum connatum (Peck) G. Lister, Mycet. ed. 2. 71. 1911. Not P. connatum Schum., 1803, nor P. connatum Ditmar, 1817.

Sporangiate to plasmodiocarpous; sporangia gregarious, globose to reniform, stalked or sessile on a constricted and often dark and cupulate base, 0.3–1 mm in diameter, the sessile forms merging into short plasmodicarps, the fructifications often closely compacted into groups of 2–10 or more within the larger fruitings; peridium membranous, densely incrusted with ashy white calcareous deposits, especially above, but nearly limeless sporangia frequently intermixed with them; stalk, when present, irregular, usually tapering upward, deeply plicate-furrowed, opaque, dark or covered with white calcareous granules; capillitium abundant, the nodes variable in size and shape, connected by rather long hyaline threads, the junctions not always nodulose; spores black

in mass, olivaceous brown by transmitted light, minutely warted, mostly 10-11.5

TYPE LOCALITY: Portville, New York.

HABITAT: Dead wood and bark.

 μ in diameter. Plasmodium white or gray.

DISTRIBUTION: Northern United States and Canada; West Indies; Europe; ?New Zealand.

ILLUSTRATIONS: Jour. Cinc. Soc. Nat. Hist. 19: pl. 2, f. 59; Lister, Mycet. ed. 3. pl. 40, c-e.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2694 (as P. leucophaeum); Jaap, Myxom. Exs. 85; Brândză, Myxom. Roum. II. 1: 11; III. 1: 4(NY); 25(IA); Thaxter, Rel. Farl. 811, 813.

As Hagelstein (1944) emphasized, this is a very variable species and difficult

FIG. 273 Plate XXX to define, but perhaps not to the extent which he suggests. The very large fruitings and the conspicuous way in which the sporangia are clustered in most of them, makes it possible to suspect what they are in the field, and when this is confirmed by the large, angular nodes and rather distinctive smoky olivaceous spores as seen under the microscope the identity is certain. It remains true that border-line collections are too numerous for entire comfort.

Morgan referred his material to *Physarum connexum* Link, Ges. Nat. Freunde Berlin Mag. 7: 42. 1815, not "P. connexum Morgan," as cited in the Lister monograph, and the combination so attributed to Morgan has been copied extensively. Link's name has been associated with other species, particularly P. leucophaeum, but its identity must remain uncertain. Physarum nephroideum Rost. is cited by G. Lister, in the second and third editions of the Mycetozoa, as in part a synonym of P. connatum (Peck) G. Lister.

The species is common in eastern North America; apparently less so elsewhere. Our single specimen from New Zealand referred here is one of the border-line forms.

FIG. 274 Plate XXX Physarum nucleatum Rex, Proc. Acad. Phila. 43: 389. 1891.

Sporangia stipitate, spherical, white, 0.3–0.5 mm in diameter, erect or nodding, rarely plasmodiocarpous; peridium membranous, studded with rounded, white calcareous nodules, the lime sometimes scanty and the peridium then metallic, the lower portion thicker and remaining as a collar on the stem after the upper portion has disappeared; stalk slender, subulate, yellowish white, rugose, not calcareous, 0.5–1.5 mm long; columella usually lacking, when present, small and inconspicuous; capillitium dense, white, the nodes small, white, rounded, aggregated in the center to form a conspicuous ball of lime, but scarcely forming a pseudocolumella, free from the stalk; spores black in mass, clear lilaceous by transmitted light, minutely spinulose, 6.5–7.5 μ in diameter. Plasmodium gray.

TYPE LOCALITY: Philadelphia, Pennsylvania.

HABITAT: Dead wood.

DISTRIBUTION: New York to Oregon south to Nicaragua; England; Rumania; South Africa; Japan; the tropics of both hemispheres.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 35; Macbr. & Martin, Myxom. pl. 5, f. 85–87; Hattori, Myxom. Nasu pl. 16, f. 6.

G. Lister, Mon. ed. 3, p. 44, adds as a possible synonym *P. simile* Rost., Mon. App. 6. 1876, but, as she notes, Rostafinski says that that has a columella. The reference to plasmodiocarpous developments is based on the same source. We have seen no plasmodiocarpous fruiting.

In general, the rather small, long-stalked sporangia suggest *P. globuliferum*, but there is usually no columella, the stalks are not limy and the small, pale violet spores are distinctive.

The central ball of lime, composed of aggregated but not fused nodes, is readily observable in sporangia from which the spores have been dispersed, but careful dissection of those which are intact is necessary before it can be seen.

Physarum nudum Macbr., in Peck & Gilbert, Am. Jour. Bot. 19: 134. 1932.

FIG. 275 Plate XXX Sporangia gregarious or crowded, pale gray when lime is present to dark gray when it is lacking, subglobose to pulvinate on a restricted base, or rarely forming short plasmodiocarps, (0.2-)0.3-0.5(-0.7) mm in diameter, sometimes borne on a weak stalk which may equal the height of the sporangium; peridium

single, membranous, delicate, sometimes bearing thin flakes of lime covering nearly all of surface, sometimes nearly limeless and then iridescent; stalk, when present, pallid, slender, prostrate or erect, often an extension of hypothallus; hypothallus reticulate or expanded, colorless or darkened by accretions from substratum; capillitium delicate, netted and appearing white and badhamioid under binocular, but colorless and physaroid by transmitted light, nearly limeless, but with a few scattered nodes and many swollen, limeless junctions; spores dark brown in mass, violaceous brown by transmitted light, globose, minutely spinulose, $(9-)10-12(-13)~\mu$ in diameter, or elliptical and then slightly longer and narrower, sometimes aggregated into small, loose clusters of mostly 5–15 spores, these even more loosely grouped into larger clumps. Plasmodium yellow.

TYPE LOCALITY: Washington.
HABITAT: Dead leaves and wood.

DISTRIBUTION: Washington, Oregon; Poland.

Macbride and Martin (1934) recognized this species. Hagelstein (1944) declared that the "cotype," possibly a portion of Gilbert's collection, was a limeless form of Badhamia panicea, with the characteristic reddish base and reddish stalks of that species. Martin (1949) accepted Hagelstein's disposition. At that time the type and paratype had been mislaid. They have since been found and neither shows the characteristics mentioned by Hagelstein. A specimen collected in Poland and determined by Krzemieniewska, was used extensively in cultural studies by Rakoczy (1962 a, b). Dr. Rakoczy has generously furnished an ample collection of the Polish strain, which is more limy and differs in other minor respects from the type, but not to a greater extent than is to be expected within the limits of a species, and that has been the basis for the emendation of the original description given above. The tendency of the spores to be grouped into clusters has been seen only in the Polish specimens. Also in some of these sporangia the lime on the peridium forms a reticulate pattern suggestive of that of P. gilkeyanum.

Physarum nutans Pers., Am. Bot. Usteri 15: 6. 1795.

Sphaerocarpus albus Bull., Hist. Champ. Fr. 137. 1791. Not Physarum album Fries, 1829.

Stemonitis alba (Bull.) J. F. Gmel., Syst. Nat. 2: 1469. 1791. Not S. alba Schrank, 1789.

Trichia nutans Trent., in Roth, Catalecta Bot. 1: 227. 1797. Not T. nutans Bull. 1791.

Physarum bulbiforme Schum., Enum. Pl. Saell. 2: 200. 1803.

Physarum albopunctatum Schum., Enum. Pl. Saell. 2: 200. 1803.

Physarum marginatum Schum., Enum. Pl. Saell. 2: 202. 1803.

Physarum pini Schum., Enum. Pl. Saell. 2: 203. 1803.

Physarum furfuraceum Schum., Enum. Pl. Saell. 2: 204. 1803.

Trichia cernua Schum., Enum. Pl. Saell. 2: 211. 1803. Not T. cernua Poir. 1808.

Trichia alba (Bull.) DC., Fl. Fr. 2: 252. 1805. Probably not T. alba With. 1796.

Didymium marginatum (Schum.) Fries, Syst. Myc. 3: 115. 1829.

Didymium furfuraceum (Schum.) Fries, Syst. Myc. 3: 116. 1829.

Physarum cernuum (Schum.) Fries, Syst. Myc. 3: 130. 1829.

Physarum gracilentum Fries, Syst. Myc. 3: 133. 1829.

FIG. 276 Plate XXX Tilmadoche cernua (Schum.) Fries, Summa Veg. Scand. 454. 1849.

Tilmadoche nutans (Pers.) Rost., Mon. 127. 1874.

Tilmadoche pini (Schum.) Rost., Mon. 128. 1874.

Tilmadoche gracilenta (Fries) Rost., Mon. 129. 1874.

Tilmadoche alba (Bull.) Macbr., N. Am. Slime-Moulds 58. 1899.

Sporangia stalked, gregarious, depressed-spherical to lenticular, umbilicate, 0.4–0.7 mm in diameter, sometimes smaller, pure white or, when lime is scanty, dull gray, usually nodding, less commonly erect; peridium thin, lobate or petaloid or not rarely annulate in dehiscence, the basal portion persistent; capillitium delicate, persistent, the threads originating from the base, branching dichotomously, and forming a dense network bearing rather few elongate or rounded, white, calcareous nodes; stalk long, black or fuscous below, tapering upward to the tenuous, white apex; spores black in mass, pale lilaceous brown by transmitted light, minutely roughened, $(7-)8-9(-10)~\mu$ in diameter. Plasmodium bright yellow to greenish yellow, changing to gray or watery white before fruiting.

TYPE LOCALITY: Europe.

HABITAT: Dead wood and old fungi.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Bull. Herb. Fr. pl. 407, f. 3; 470 f. 1; Lister Mycet. ed. 3. pl. 37; Macbr. & Martin, Myxom. pl. 6, f. 125, 126; Hattori, Myxom. Nasu pl. 16, f. 4; Ind. Jour. Bot. Soc. 33: 178, f. 1, A-D.

EXSICCATI: Jaap, Myxom. Exs. 3, 102; Ellis & Ev., N. Am. Fungi 2693 (as P. leucophaeum); Brândză, Myxom. Roum. I. 1: 7(NY).

A very common species, distinctive in its usual expression. Most commonly confused with pale, bleached specimens of *P. viride* which, however, usually retain some evidence of their former color. Also, when erect, easily confused with other small, white, stalked Physarums, particularly with *P. leucophaeum* and *P. stellatum*. From the former, it may be distinguished by its small fusiform nodes and small bright spores; from the latter by its lack of a central limy mass in the sporangial cavity and by its oblate and usually nodding sporangia.

The variety leucophaeum A. Lister, Mycet. 51. 1894, is, of course, what is here treated as P. leucophaeum. The variety robustum A. Lister, Mycet. 51. 1894, with large, often angular nodes and somewhat larger spores, may well belong elsewhere; see comments by Hagelstein (1944, p. 57). "Physarum albipes de By.," Zeitschr. Wiss. Zool. 10: 95. 1866, is cited by G. Lister, Mycet. ed. 3, p. 48, as a possible synonym of this variety. It is not certain that this name was validly published; if it was, it is a later homonym and perhaps a synonym of P. albipes Link, Ges. Nat. Freunde Berlin Mag. 3: 27. 1809. The form de Bary studied may, as Rostafinski suggested, be a phase of P. leucophaeum.

The long list of possible synonyms cited in the third edition of the Lister monograph and not included above are either listed under other species or noted in the appendix.

Physarum oblatum Macbr., Bull. Nat. Hist. Univ. Iowa 2: 384. 1893.

Craterium maydis Morgan, Jour. Cinc. Soc. Nat. Hist. 19: 15. 1896.

Physarum maydis (Morgan) Torrend, Broteria 7: 133. 1908.

Sporangiate, stalked, rarely sessile or somewhat plasmodiocarpous, globose, depressed-globose or flabellate, (0.3-)0.4-0.6(-0.7) mm in diameter, orange-yellow, bright yellow, to ochraceous or nearly white above, with a darker base; peridium membranous above, roughened with clusters of lime

FIG. 277 Plate XXX granules, the base thicker and tending to persist as a cup; stalk reddish brown or smoky, translucent, slender, furrowed, mostly 1–3 times the diameter of the sporangium in height but sometimes shorter and thicker, or lacking; columella none; capillitium composed of angular and branching nodes, concolorous with the peridium or a little darker, connected by hyaline or yellowish threads or badhamioid strands; spores blackish brown in mass, bright violaceous brown by transmitted light, minutely spinulose, often bearing clusters of larger warts, 9–13 μ in diameter. Plasmodium bright yellow or yellowish green.

TYPE LOCALITY: Iowa City, Iowa.

HABITAT: Dead leaves, herbaceous stems and wood.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Bull. Nat. Hist. Univ. Iowa 2: pl. 11, f. 3, 3a, 3b; Jour. Cinc. Soc. Nat. Hist. 19: pl. 2, f. 57; Lister, Mycet. ed. 3. pl. 32, c-e; Hattori, Myxom. Nasu pl. 16, f. 2.

EXSICCATI: Thaxter, Rel. Farl. 808; Jaap, Myxom. Exs. 21 (both as P. auriscalpium).

Both Lister and Hagelstein cite P. ornatum Peck, Ann. Rep. N. Y. State Museum 31: 40. 1879, as a possible synonym. Hagelstein examined what is left of the type and found only stalks remaining. It must, therefore, be regarded as a doubtful species. We have a specimen from Maine, collected by F. L. Harvey in 1896 and referred to Peck's species, which seems to be P. oblatum. It does not fit Peck's description of the peridium as "greenish-cinereous, dotted with small yellow granules." Macbride in his original description, referred to the head as "depressed globose." His illustration shows it as spherical. It is somewhat depressed in some specimens, but not notably so. We have several specimens from Iowa determined by Macbride of which one, collected by Shimek in 1891, seems clearly to be the type. What is certainly part of the same collection was sent by Macbride to Rex and by him to Wingate, who corrected it to P. ornatum Peck, but, like the Maine specimen, it does not agree with Peck's description. Authentic specimens of Craterium maydis from Morgan agree entirely with our material of P. oblatum and the cup-like base is no more pronounced in them than in most of the others. That, the rather large, bright colored spores, and the large, irregular lime knots are the best marks of the species. The color, while commonly bright orange or yellow, may be ochraceous or nearly white, but the color gradation is complete. Even in the same collection, the color of different sporangia may vary and the same is even more true of the length and thickness of the stalks.

The species has been confused with P. auriscalpium, from which it may be distinguished by its more regularly stalked and sporangiate habit, its longer stalks and especially by the peridium with delicate scales above and thickened basal portion, and also with P. viride, which has entirely different nodes, a much more delicate peridium and a regularly oblate and often umbilicate sporangium.

Physarum limonium Nann.-Brem. is somewhat similar; see comment under P. auriscalpium.

Physarum ovisporum G. Lister, Jour. Bot. 59: 90. 1921.

Sporangia scattered, white, sessile, pulvinate on a restricted base, (0.2–) 0.5–0.8 mm in diameter, or forming straight, curved, or irregular plasmodiocarps; peridium minutely roughened with deposits of lime granules; often with smoother areas where the lime deposits are scanty, black at base; capillitium composed of numerous rounded or somewhat angular nodes, varying in size but mostly small, connected by short hyaline threads; spores black in mass,

FIG. 278
Plate XXX

deep purple-brown by transmitted light, minutely warted or spiny, often with a pale line of dehiscence, varying from oval, 12–13 \times 10–12 μ to globose, 9–11 μ in diameter. Plasmodium white.

TYPE LOCALITY: England.

HABITAT: Dead leaves, surface litter, and wood.

DISTRIBUTION: England; Switzerland; PNew York; PKansas.

ILLUSTRATION: Lister, Mycet. ed. 3. pl. 202, a-c.

In the original description, the oval spores with the pale band are stressed. Hagelstein (1944) says typical specimens have been found in Kansas. We have one of Brooks' specimens from Kansas and one of Hagelstein's from New York. In neither have we found the oval spores, nor do they occur in the specimen from Switzerland, here illustrated, which does, however, have the small nodes and rather delicate peridium. The oval spores as described by Lister suggest those of Badhamia ovispora but the peridium and capillitium are quite distinct.

Pending further information, this species must be regarded as of doubtful validity, but it seems desirable to maintain it provisionally.

Physarum penetrale Rex, Proc. Acad. Phila. 43: 389. 1891.

FIG. 279 Plate XXXI Cytidium penetrale (Rex) Morgan, Jour. Cinc. Soc. Nat. Hist. 19: 11. 1896. Sporangia stipitate, scattered, ellipsoidal and prolate, varying to pyriform or subglobose, 0.4–0.6 mm in height, 0.3–0.4 mm in diameter, erect or nodding, total height 1–2 mm; peridium thin, translucent, greenish gray to yellowish green, darkened by the underlying spore mass, sparsely studded with rounded, pale yellow to yellowish gray calcareous scales, rupturing to the base in two to four segments or irregularly; capillitium dense, persistent, the nodes small, rounded, pale yellow, fading to white; columella a continuation of the stem, not calcareous, reaching to about four-fifths the height of the sporangium, acuminate, or enlarged at the tip, orange-brown to dull yellow or pallid; stalk variable in height, slender, subulate, rugulose, translucent, not calcareous, dull red or orange-brown, often flattened laterally at the base; spores dark brown in mass, brownish lilac by transmitted light, very minutely spinulose, the spines aggregated in denser patches in places, 6–7 μ in diameter. Plasmodium orange-yellow.

TYPE LOCALITY: Philadelphia, Pennsylvania.

HABITAT: Dead wood and moss.

DISTRIBUTION: Maine to Ontario, south to Georgia and Iowa, and in Washington and Oregon; Europe; Asia; Africa.

ILLUSTRATIONS: Jour. Cinc. Soc. Nat. Hist. 19: pl. 1, f. 54; Lister, Mycet. ed. 3. pl. 36; Macbr. & Martin, Myxom. pl. 5, f. 65–67; Hattori, Myxom. Nasu pl. 17, f. 1.

EXSICCATI: Brândză, Myxom. Roum. II. 1: 17; III. 1: 11(NY); 17, 18(IA).

The long, slender columella, reaching nearly to the top of the sporangial cavity and occasionally attaining it, the characteristic elongate-ovate sporangia, usually with olivaceous tints, erect on slender stalks, and the small, pale spores are the marks of this distinctive and attractive but rather uncommon species.

Physarum perfectum M. E. Peck, in Peck & Gilbert, Am. Jour. Bot. 19: 134. 1932.

Sporangia loosely gregarious, grayish white, globose, stipitate, 0.6–0.8 mm in diameter; hypothallus very thin, colorless, widely effused; stalk yellowish white, stout, calcareous, nearly smooth, slightly narrowed upward, equalling or a little surpassing in height the diameter of the sporangium; columella calcareous, well developed, white, conic, nearly one-third the height of the sporangial cavity; peridium a thin membrane, evenly granular with included lime, and thickly sprinkled with round, mainly superficial, white scales of lime; capillitium moderately dense with numerous rounded or somewhat elongated, pale yellow, calcareous nodes; spores black in mass, brown by transmitted light, minutely roughened, 9–11 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Salem, Oregon. HABITAT: Decaying bark of *Populus*.

DISTRIBUTION: Known only from the type locality. ILLUSTRATION: Am. Jour. Bot. 19: pl. 11. f. 3.

Hagelstein (1944, p. 34) says "perhaps a pale, robust form of *P. melleum*." In addition to the large size, the stout columella and the larger and darker spores make this improbable. Our scanty specimen, undoubtedly representing one of the original collections on which the species was based, does not suggest *P. melleum* but is inadequate for illustration. The illustration accompanying the original description, cited above, gives a good idea of the species.

Physarum pezizoideum (Jungh.) Pav. & Lag., Bull. Soc. Myc. Fr. 19: 87. 1903.

Trichamphora pezizoidea Jungh., Crypt. Java 12. 1838.

Didymium zeylanicum Berk., Jour. Bot. & Kew Misc. 6: 230. 1854.

Trichamphora fuckeliana Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27–28: 71. 1873.

Chondrioderma pezizoides (Jungh.) Rost., Mon. 424. 1875.

Badhamia fuckeliana (Rost.) Rost., Mon. App. 2. 1876.

Chondrioderma zeylanicum (Berk.) Rost., Mon. App. 15. 1876.

Chondrioderma muelleri Rost., Mon. App. 15. 1876.

Chondrioderma berkeleyanum Rost., Mon. App. 16. 1876.

Didymium australe Massee, in Cooke, Grevillea 17: 7. 1888 (as australis). Not P. australe Berk. 1855.

Didymium pezizoideum (Jungh.) Massee, Mon. 239. 1892.

Didymium parasiticum Sacc. & Syd., in Sacc., Syll. Fung. 14: 836. 1899.

Badhamia pezizoidea (Jungh.) Buchet, Bull. Soc. Myc. Fr. 55: 116. 1939.

Sporangia gregarious, stipitate, discoidal or saucer-shaped, pure white or grayish white from spore-mass within, 0.8–1.3 mm broad, the disk 0.2–0.4 mm thick, the total height 1–3 mm, erect or nodding; peridium thin, membranous, breaking irregularly, persistent; stalk slender, subulate, striate, reddish brown, translucent; capillitium variable, sometimes almost badhamioid, sometimes nearly limeless; spores pale violet-brown, spinulose or nearly smooth, 9–14 (–17) μ in diameter. Plasmodium grayish white.

TYPE LOCALITY: Java.

HABITAT: Dead wood, leaves, and litter, including sporophores of basidiomycetous fungi. FIG. 280 Plate XXXI DISTRIBUTION: Widely distributed in old world tropics, from India to Australia; rare in Europe; Liberia; Sierra Leone; Congo; Tahiti; Japan; Philippines; rare in the western hemisphere, but known from Florida, the West Indies and South America.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 72; Brittonia 16: 341, f. 1, 2. EXSICCATI: Brândză, Myxom. Roum. II. 1: 30(NY); Thaxter, Rel. Farl. 813.

As the synonymy indicates, this species has been referred to various genera and is the only species of the widely recognized genus *Trichamphora*, which, however, is too closely allied to *Physarum* and particularly to *P. javanicum* to warrant separation.

The remarkable range in spore size, color and ornamentation has been commented upon by G. Lister (1925, p. 72) and Hagelstein (1944, p. 56). Farr believed that the specimens she studied could be divided into two groups worthy of varietal rank and proposed the variety microsporum Farr, Brittonia 16: 340. 1964, for the forms with small, $8-10(-11)~\mu$, relatively pale and verruculose or nearly smooth spores, thus automatically creating the variety pezizoideum, with large, $10-17(-19)~\mu$, darker and echinulate spores. This seems to be one of the rare cases where varietal recognition may be justified.

FIG. 281 Plate XXXI Physarum polycephalum Schw., Schr. Natur. Ges. Leipzig 1: 63. 1822.

Didymium polycephalum (Schw.) Fries, Syst. Myc. 3: 122. 1829.

Didymium polymorphum Mont., Ann. Sci. Nat. II. 8: 361. 1837.

Didymium gyrocephalum Mont., Ann. Sci. Nat. II. 8: 362. 1837.

Didymium obrusseum Berk. & Curt., Jour. Linn. Soc. 10: 348. 1868.

Didymium tenerrimum Berk. & Curt., Jour. Linn. Soc. 10: 348. 1868.

Didymium luteogriseum Berk. & Curt., Grevillea 2: 65. 1873.

Physarum polymorphum (Mont.) Rost., Mon. 107. 1874.

Tilmadoche gyrocephala (Mont.) Rost., Mon. 131. 1874.

Physarum obrusseum (Berk. & Curt.) Rost., Mon. App. 11. 1876.

Physarum multiplex Peck, Bull. Torrey Club 11: 50. 1884.

Tilmadoche polycephala (Schw.) Macbr., N. Am. Slime-Moulds 57. 1899.

Sporangia stalked, gregarious, yellow, yellowish gray, gray or rarely white; sporangia irregular, gyrose-confluent, often forming a helvelloid cluster, umbilicate below; peridium thin, ashy, fragile, covered with evanescent yellow or white squamules; capillitium dense, delicate, often expanding and becoming open, the nodes yellow or white, fusoid or irregular; stalks yellow, translucent, usually long, slender, flexuous, often confluent, arising from an expanded, membranous hypothallus; spores black in mass, violaceous brown by transmitted light, minutely spinulose, 9–11 μ in diameter. Plasmodium yellow or greenish yellow, often very extensive.

TYPE LOCALITY: Wilkes County, North Carolina.

HABITAT: Dead wood and fleshy fungi, often fruiting on adjacent surfaces, including living plants.

DISTRIBUTION: Widely distributed in the United States; reported from the West Indies; Costa Rica, Brazil, and Uruguay; France; Rumania; Borneo; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 34; Macbr. & Martin, Myxom. pl. 6, f. 122.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2699; Ellis & Ev., Fungi Columb. 404; Brândză, Myxom. Roum. I. 1: 5; II. 1: 9; III. 1: 3; 103(NY); 4(IA).

This species is familiar because of the ease with which its plasmodium may be grown in the laboratory, hence it has been used extensively in physiological studies. The plasmodium often occurs on the hymenium of fleshy fungi, covering the gills of agarics and absorbing the spores and softer parts of the hymenium. To what extent associated bacteria play a part in this process is not clear.

The variety obrusseum (Berk. & Curt.) A. Lister, Mon. 48. 1895, based on Didymium obrusseum Berk. & Curt., from Texas, differs from the typical form only in the simple sporangia. As Lister remarks, such sporangia commonly occur in other fruitings. Farr (Brittonia 16: 339. 1964), on the basis of study of West Indian collections, felt that the variety should be recognized. However, Alexopoulos & Henney (in Alexopoulos, 1969) found that a culture of the obrusseum type from Jamaica produced typical gyrose heads in culture, both alone and when crossed with an obrusseum type from Costa Rica, thus strongly supporting the inference that the simple sporangia are no more than responses to environmental conditions at the time of fruiting.

Physarum psittacinum Ditmar, in Sturm, Deuts. Fl. Pilze 1: 125. 1817.

Physarum carlylei Massee, in Cooke, Grevillea 17: 56. 1889.

Sporangia scattered or gregarious, stalked, globose, depressed-globose, or reniform, 0.5–0.8 mm in diameter, the total height 0.8–1.2 mm, rarely sessile or approaching plasmodiocarpous; peridium bronze or iridescent blue, more or less mottled with flattened, orange, granular or subcrystalline flecks; stalk cylindric or tapering slightly upward, rugose, limeless, orange, orange-red, fulvous or yellow, rising from a small, concolorous hypothallus; columella none, capillitium dense, persistent, the threads hyaline to dark, often flattened, the brilliant orange nodes numerous and often confluent in the center; spores dark brown in mass, pale brown by transmitted light, minutely but distinctly warted, the warts often in groups, 8–10 μ in diameter. Plasmodium yellow or orange.

TYPE LOCALITY: Germany.

HABITAT: Dead wood and leaves.

DISTRIBUTION: Western Europe; Rumania; in North America, Quebec and New England to Minnesota, south to Florida and West Virginia; Washington; Japan; Philippines.

ILLUSTRATIONS: Massee, Mon. pl. 10, f. 240, 241; Lister, Mycet. ed. 3. pl. 29; Hattori, Myxom. Nasu pl. 17, f. 5.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2492; Jaap, Myxom. Exs. 22.

The dark heads with metallic peridium on the bright, more or less orange stalks make this rather small and uncommon species fairly conspicuous when found. The var. fulvum A. & G. Lister, Jour. Bot. 44: 228. 1906, based on yellow stalks, should be included in the concept of the species.

The nature of the yellow bodies in the peridium, described as crystalline by G. Lister, is not known. They are usually apparent in mounts of the peridium when it is freed from spores, and are roughly two or three times the diameter of the spores, somewhat irregular in shape and sometimes compound. They do, at times, look somewhat like crystalline aggregates but do not appear to be calcareous. Similar, but larger and more irregular bodies may occur in the stalks. Miss Lister compared the yellow flakes in the peridium of *P. dictyospermum* with these.

FIG. 282 Plate XXXI FIG. 283 Plate XXXI Physarum pulcherrimum Berk. & Rav., Grevillea 2: 65. 1873.

Stemonitis porphyra Berk. & Curt., Grevillea 2: 69. 1873.

Physarum atrorubrum Peck, Ann. Rep. N. Y. State Mus. 31: 40. 1879.

Cytidium pulcherrimum (Berk. & Rav.) Morgan, Jour. Cinc., Soc. Nat. Hist. 19. 8 1896

Sporangia stalked, gregarious, globose, (0.2-)0.4-0.5(-0.7) mm in diameter, even or somewhat wrinkled, bright to deep maroon, reddish violet, or purple; stalk cylindric, even, impregnated with lime, concolorous or darker, varying from 1–4 times the diameter of the sporangium; columella small, conical, sometimes lacking; capillitium delicate, dense, the numerous, small, rounded, purple-red nodes connected by pinkish threads, with larger, often irregular nodes toward center, these rarely united into a distinct pseudo-columella; spores dark brown in mass, pale pinkish lilac by transmitted light, globose, minutely warted, the warts often clustered, 7.5–8.5 μ in diameter. Plasmodium deep purple or dark red.

TYPE LOCALITY: South Carolina.

HABITAT: Dead wood.

DISTRIBUTION: Canada and Eastern United States, from Nova Scotia to Colorado and Louisiana; Washington; New Mexico; Europe; Asia; Philippines.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 19; Hattori, Myxom. Nasu pl. 17, f. 2.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2897; Ellis & Ev., Fungi Columb. 1395; Brândză, Myxom, Roum. III. 1: 8(NY); 1, 2(IA); Thaxter, Rel. Farl. 415.

Close to *P. roseum*, from which it differs not only in its dense, persistent, rosaceous capillitium with numerous small, rounded nodes toward the periphery, and the presence of a columella, but in its generally darker, deep maroon or purple color, its more robust habit, and usually longer, and more opaque and limy stalks. As noted under *P. roseum*, the differences from that species do not appear to be constant, and it is very probable that the two species should be united, with proper modification of the description.

"P. atropurpureum Peck" in Berlese, Sacc. Syll. Fung. 7: 348. 1888, is an erroneus citation of P. atropubrum Peck.

FIG. 284 Plate XXXI Physarum pulcherripes Peck, Bull. Buffalo Soc. Nat. Sci. 1: 64, July, 1873.

Physarum aurantium var. rufipes Alb. & Schw., Consp. Fung. 94. 1805.

?Physarum aureum var. chrysopus Lév., Ann. Sci. Nat. Bot. III. 5: 166. 1846.

Didymium erythrinum Berk., Grevillea 2: 52, Oct. 1873.

Didymium ravenelii Berk. & Curt., Grevillea 2: 53. Oct. 1873.

Physarum petersii Berk. & Curt., Grevillea 2: 66. Oct. 1873.

Physarum schumacheri var. rufipes Rost., Mon. 99. 1874.

Physarum psittacinum var. ravenelii Rost., Mon. App. 8. 1876 (as ravenalii).

Physarum pulchripes Peck, ex A. Berl., Sacc., Syll. Fung. 7: 349. 1888.

Physarum ravenelii (Berk. & Curt.) Massee, Mon. 281. 1892.

Cytidium rufipes (Alb. & Schw.) Morgan, Jour. Cinc. Soc. Nat. Hist. 19: 9. 1896.

Physarum rufipes (Alb. & Schw.) Macbr., N. Am. Slime-Moulds 50. 1899.

Sporangia globose, stipitate, (0.3-)0.4-0.6(-0.7) mm in diameter, orange-brown to tawny or whitish, calcareous above, dark iridescent beneath, the walls thin, deciduous; stalk slender, erect, calcareous, up to 1.5 mm long, deep red, orange or pale at the apex, sometimes shading to black below, supported on a well-developed hypothallus, total height usually 1–2 mm; columella small, conic, rarely subglobose; capillitium dense, slightly elastic, the meshes small, the nodes reddish or yellow, small, rounded; spores dark violaceous gray in mass, pale lilaceous brown by transmitted light, minutely warted, with clusters of darker warts, 8–10 μ in diameter. Plasmodium yellow.

TYPE LOCALITY: New York. HABITAT: Dead Wood.

DISTRIBUTION: Massachusetts to Ontario, south to Florida and Texas; Washington, Oregon; Panama; Jamaica; Ireland; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 17; Macbr. & Martin, Myxom. pl. 5, f. 81, 82.

EXSICCATI: Ellis & Ev., N. Am. Fungi 3300; Thaxter, Rel. Farl. 416.

The varietal names of Albertini and Schweinitz and of Léveillé are cited by Morgan, who adopted the formers' varietal name as a specific epithet. Morgan's decision was presumably based only on specimens so labelled by later authors, and it remains doubtful to what the varietal names originally applied. In any event, Peck's name represents the first valid combination in *Physarum. P. aureum* Pers. and *P. aurantium* Pers. are believed to refer to forms of *P. viride. P. pulchripes* Peck ex Berl. was, as indicated by the reference, probably an error rather than a correction, but the name was adopted by the Listers in the first two editions of the Mycetozoa and widely applied.

When perfectly matured, the species is striking and conspicuous. However, the peridium is so fragile that most collections are rather dingy, with the bright stalks and what is left of the peridium obscured by the sooty mass of spores.

Physarum pusillum (Berk. & Curt.) G. Lister, Mycet. ed. 2. 64. 1911.

Didymium pusillum Berk. & Curt., Grevillea 2: 53. 1873.

Badhamia nodulosa Massee, Jour. Myc. 5: 186. 1889.

Physarum calidris A. Lister, Jour. Bot. 29: 258. 1891.

Physarum mucoroides Schilb., Bot. Centralbl. 66: 84. 1896.

Craterium nodulosum (Massee) Morgan, Jour. Cinc. Soc. Nat. Hist. 19: 15. 1896.

Physarum gravidum Morgan, Jour. Cinc. Soc. Nat. Hist. 19: 24. 1896.

Physarum nodulosum (Massee) Macbr., N. Am. Slime-Moulds 51. 1899.

Sporangia stipitate, gregarious, globose or flattened and then slightly umbilicate below, small, 0.4–0.6 mm in diameter, white or grayish white usually with a brown, thickened and often persistent base; peridium thin, rugose, more or less incrusted with lime, breaking up irregularly above, sometimes remaining as a cup below; stalk limeless, usually slender, cylindrical, equal to or exceeding the sporangium, but varying to subulate and then shorter, rugose, bright brown, merging into the base of the sporangium; total height 1–2 mm; columella none; capillitium variable, the nodes white, angular and scattered, sometimes approaching badhamioid; spores black in mass, lilaceous brown by transmitted light, minutely warted, $(9-)10-12~\mu$ in diameter. Plasmodium watery white.

FIG. 285 Plate XXXI TYPE LOCALITY: Aiken, South Carolina.

HABITAT: Dead leaves and herbaceous litter, often on compost.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Jour. Myc. 5: pl. 14, f. 6; Lister, Mycet. ed. 3. pl. 43; Hattori, Myxom. Nasu pl. 16, f. 3.

EXSICCATI: Ellis, N. Am. Fungi 614 (as Physarum leucophaeum); Brândză, Myxom. Roum., II. 1: 16(NY).

This is a rather difficult species to define. Hagelstein (1944, p. 54) comments on its variability and also cites several exsiccati, including *Physarum nodulosum* Rav., Fung. Car. 479. 1860, apparently a nomen nudum. Massee based his *Badhamia nodulosa* on this specimen, thus emphasizing the frequently badhamioid character of the capillitium. This is often associated with a firm, persistent, cuplike peridial base, which led Morgan to place such specimens in *Craterium. Badhamia iowensis* Macbr. was said by Farr (Mycologia 51: 598. 1959), to be a typical representative of the species, but she has since (in litt.) suggested it may be closer to *P. oblatum*. In the present treatment it is retained as distinct.

Another difficulty, noted by G. Lister, Mycet. ed. 3, p. 45, is due to the fact that the type packet at Kew included the present species and also a fruiting of what is here called *Didymium iridis*.

Small, rather neat, white sporangia which do not fit into *P. nutans*, *P. leu-cophaeum* or similar species, and which have angular nodes and a more or less brown and persistent peridial base, characterize the species as it is currently understood.

Physarum retisporum Martin, Thind & Rehill, Mycologia 51: 159. 1959.

FIG. 286
Plate XXXI

Fructification plasmodiocarpous, often broken into sporangiate segments in more or less plasmodiocarpous arrangement, strongly compressed laterally, bright yellow-brown, dehiscent at outer margin by a preformed fissure; peridium double, the outer layer smooth, pale yellow within, except at white dehiscent margin, composed of densely compressed globose, yellow lime granules 1–2 μ in diameter, the closely attached inner membrane transparent, iridescent, colorless except as colored by adhering granules of the outer layer, tending to separate from outer layer at dehiscence; capillitium dense, the nodes large, pale yellow, angular, often spike-like, attached to base or peridium and penetrating the spore chamber, massed with others into irregular transverse bands tending to separate the chamber into compartment-like sections, the nodes connected by pale yellow, noncalcareous tubules; spores black in mass, dark purplish brown under the lens, strongly reticulate, 9–11 μ in diameter. Plasmodium bright yellow or yellowish orange.

TYPE LOCALITY: Mussoorie, India.

HABITAT: Dead leaves.

DISTRIBUTION: India; Philippines.

ILLUSTRATION: Mycologia 51: 160, f. 1.

The Diderma-like peridium resembles that of Leocarpus fragilis, but the shape, capillitium and spores are quite different. The shape is similar to that of P. bivalve, but the other characters, and particularly the strongly reticulate spores, mark it at once as clearly distinct from that species. Physarum durjoylingum Lodhi, Indian Slime-Moulds 7. 1934, pl. 4, may be this species. We have seen no material, but if it is the same, Lodhi's name takes precedence.

We now have three different collections from the type locality.

Physarum rigidum (G. Lister) G. Lister, Mycet. ed. 3. 36. 1925.

Physarum viride var. rigidum G. Lister, Mycet. ed. 2. 56. 1911.

Sporangia stalked, gregarious, lenticular, often umbilicate above, yellow, dull orange, or iridescent from lack of lime; stalk slender, orange or yellow above, dark below from included amorphous matter, 0.3–1.5 mm long; capillitium of sparingly branched threads with long, spike-like, orange-yellow nodes, or consisting almost entirely of slender, rod-like tubes enclosing yellow lime granules; spores rich violet-brown by transmitted light; minutely spinulose, 9–10 μ in diameter. Plasmodium yellow.

TYPE LOCALITY: Japan.

HABITAT: Dead wood and gelatinous and fleshy fungi.

DISTRIBUTION: Southern and eastern Asia; New South Wales; central

Africa; Texas; Costa Rica, the West Indies; Uruguay; Brazil.

ILLUSTRATION: Lister, Mycet. ed. 3. pl. 199, a-c.

Differing from *P. viride*, of which it was at first called a variety, especially in the limy, rigid bars of the capillitium and also in the somewhat larger and darker spores.

Henney (1967) reported certain specimens grown in culture as somewhat aberrant forms of *P. flavicomum*, but all attempts to cross them with typical strains of that species have been unsuccessful. Dr. Henney now believes they should be referred to *P. rigidum* and in this opinion we concur.

Physarum roseum Berk. & Br., Jour. Linn. Soc. 14: 84. 1873.

Sporangia gregarious or scattered, stalked, globose, (0.1-)0.2-0.3(-0.5) mm in diameter; peridium membranous, scarlet or bright purplish red, nearly smooth, with innate clusters of purplish red lime granules; stalk slender, cylindrical, erect, longitudinally wrinkled, concolorous or paler, limeless, translucent, expanded at the base into a membranous hypothallus; columella none; capillitium open, the nodes few, large, bright red, angular or irregularly branched, connected by pale pinkish threads; spores purplish black in mass, pale pinkish brown by transmitted light, minutely spinulose with scattered clusters of darker warts, $7-10~\mu$ in diameter. Plasmodium maroon or bright red.

TYPE LOCALITY: Peradeniya, Ceylon.

HABITAT: Dead bark and leaves.

DISTRIBUTION: Ceylon, India, Malaya, Java, Borneo, Japan; Philippines; New Caledonia; Hawaii; New Jersey, Georgia, Florida, Mississippi.

ILLUSTRATION: Lister, Mycet. ed. 3. pl. 27.

Close to *P. pulcherrimum*, from which it is supposed to differ chiefly in its open capillitium with large, angular nodes, its bright scarlet or red color, and lack of a columella.

The original description is very brief and tells little, hence the above description incorporates additions by later authors. However, Berkeley adds: "Near P. pulcherrimum, which, however, has a much more rigid and darker stem." This scarcely warrants specific distinction, and recent collections, notably Allen 840 and 2702, from New Jersey, strongly suggest that the two should be united. If so, P. pulcherrimum (Nov. 1873) has a slight priority over P. roseum (3 Dec. 1873) and is therefore the correct name to use in that case.

Yamashiro described two varieties from southern Japan, var. discocephalum Yamashiro, Jour. Sci. Hiroshima Univ. B. 2. 3: 29. 1936, characterized by flat-

FIG. 287
Plate XXXII

tened and deeply umbilicate sporangia, and var. racemosum Yamashiro, ib. 3: 30. 1936, in which the sporangia are fused into clusters of 4–16 lobules. The description suggests that these are no more than reactions of the fruiting plasmodium to the conditions under which the fructifications were formed.

FIG. 288 Plate XXXII Physarum rubiginosum Fries, Symb. Gast. 21. 1817. Not *P. rubiginosum* Chev., 1826.

Leangium rubiginosum (Fries) Fries, Stirp. Femsj. 83. 1825.

Physarum fulvum Fries, Syst. Myc. 3: 143. 1829.

Sporangiate, sessile, subglobose or pulvinate and then elongated or occasionally with a stalk-like base, 0.5–0.8 mm in diameter, rarely plasmodiocarpous, gregarious or clustered, olive-brown, reddish brown, or scarlet, sometimes white-encrusted; peridium thin, usually rugulose, the lime deposits continuous or in the form of calcareous scales; capillitium dense, with many large, angular, branched, dull orange to rusty brown nodes, and numerous smaller ones, sometimes red inside and paler outside; spores grayish black in mass, grayish brown by transmitted light, minutely spinulose, 9–12 μ in diameter. Plasmodium orange-red or scarlet.

TYPE LOCALITY: Sweden.

HABITAT: Dead wood and moss.

DISTRIBUTION: Europe; Maine to Manitoba and Washington, south to Florida and Colorado.

ILLUSTRATIONS: Lister, Mycet. ed. 3 pl. 59; Macbr. & Martin, Myxom. pl. 4, f. 51, 52.

Close to *P. lateritium*, from which it is distinguished by its larger size, tougher peridium, more intense color, large angular nodes and darker and somewhat larger spores. *P. nasuense*, which also has nodes colored within, is described as having a distinctly double and quite different peridium.

Physarum rubronodum Martin, Jour. Wash. Acad. 38: 238. 1948.

fig. 289 *Plate* XXXII Sporangia globose to obovate or pulvinate, sessile or borne on weak, strand-like stalks produced as extensions of the hypothallus, pinkish brown, or dark when lime is scanty in the peridium, 1–1.5 mm in diameter, densely clustered on a common hypothallus; peridium double, the outer layer cartilaginous, calcareous, shining, crustose, smooth except for a coarse overlying reticulation or, when lime is scanty, dark and lacking the reticulation; the inner layer membranous, closely applied, colorless, iridescent; hypothallus prominent, silvery to yellow, venose, the veins often projecting as stalk-like extensions on which sporangia are borne; capillitium profuse, close-meshed, bearing large, fusiform or irregularly angular, scarlet or pinkish nodes, most of the junctions limeless; spores nearly black in mass, dark violaceous brown by transmitted light, slightly paler on one side, densely and somewhat irregularly verrucose, globose, 11–13 μ in diameter, or oval and correspondingly longer and narrower. Plasmodium scarlet or orange-red.

TYPE LOCALITY: Mt. Shasta, California. HABITAT: Dead wood and old cloth.

DISTRIBUTION: Known only from the type locality. ILLUSTRATION: Jour. Wash. Acad. 38: 239, f. 1.

The type, W. B. Cooke 15671a, is a beautiful example, but rather scanty and very fragile. Another specimen, W. B. C. 18126, is older and much of the outer peridium is lost, but the brilliant nodes, the characteristic capillitium and the dark spores are exactly as in the type. Portions of the latter collection have been distributed to several herbaria in the United States.

Physarum serpula Morgan, Jour. Cinc. Soc. Nat. Hist. 19: 29. 1896.

Plasmodiocarpous, forming lines, rings, or a simple network, the strands sometimes fusing laterally so that a broad fruiting surface is formed, 0.2–0.4 mm wide, often interspersed with globose sporangiate fruitings, dull yellow or ochraceous, rarely bright yellow, fading; peridium single, thin, of closely incrusted lime granules, without calcareous scales, fragile, membranous, persistent, borne on a diffuse hypothallus; capillitium dense, calcareous, the nodes numerous, large, angular, branching, pale yellow or whitish, connected by short, hyaline threads or broad limy strands, then almost badhamioid; spores globose, dull black in mass, dark brown by transmitted light, minutely warted, with a paler and smoother area on one side, 10–13 μ in diameter. Plasmodium at maturity greenish yellow.

FIG. 290 Plate XXXII

TYPE LOCALITY: Preston, Ohio.

HABITAT: Dead leaves, bark, wood, lichens, and old fungi.

DISTRIBUTION: New York to Ontario, Florida, Louisiana and Nebraska; Panama; India; Japan.

ILLUSTRATIONS: Jour. Cinc. Soc. Nat. Hist. 19: pl. 3, f. 65; Lister, Mycet. ed. 3. pl. 57; Macbr. & Martin, Myxom. pl. 3, f. 47, 48; Hattori, Myxom. Nasu pl. 18, f. 4; Jour. Ind. Bot. Soc. 34: 88, f. 3, a-e; Brittonia 13: 341. f. 5, 6.

EXSICCATI: Ellis, N. Am. Fungi 1396 (as P. gyrosum).

This species is closely related to *P. decipiens* and *P. auriscalpium* and the three species have been confused with each other. This is discussed by Farr (Brittonia 13: 339–345. 1961) and the present statement is in general although not entire, agreement with her conclusions. An excellent specimen collected by A. P. Morgan in 1893 in Ohio, labelled in his hand, and now in the Iowa collection, is designated as the lectotype. The Iowa specimen illustrated is an exact replica of this. By restricting the species to such specimens and by referring others to one of the two species mentioned, we have a clear-cut group which stands out as a distinct specific entity.

The fruitings in which the strands are laterally fused approach what could be called a flat aethalium, but in every such specimen we have, the original outline of the plasmodiocarps is more or less evident.

The species appears to be uncommon, but that may be because it is rather inconspicuous, especially when fruiting on dead wood which may be of much the same color.

Physarum sessile Brândză, Ann. Sci. Univ. Jassy 11: 116. 1921.

Sporangia gray, bluish gray or pale greenish gray, solitary or clustered, sessile, globose, 0.4–1 mm in diameter, or forming elongated, sinuous plasmodiocarps 2–10 mm long and 0.5–0.8 mm wide; peridium single, fragile, formed of hyaline calcareous granules about 1 μ in diameter; columella often present, globose, white; capillitium abundant, long-persistent, with rounded nodes, 15–25 μ in diameter, composed of granules like those of the peridium

and which, like them, tend to become dissociated readily, connected by hyaline filaments; spores smooth, pale violaceous brown, 6–8 μ in diameter. Plasmodium grayish white.

TYPE LOCALITY: Rumania. HABITAT: Dead leaves.

DISTRIBUTION: Mountains of Moldavia, where it is said to be extremely abundant. Reported by Hagelstein from Ontario and seven states of the eastern United States.

ILLUSTRATION: Bull. Soc. Myc. Fr. 44: pl. 15.

Since the original description has not been available, the preceding description is based on that of the author in Bull. Soc. Myc. Fr. 44: 260. 1929. G. Lister (Mycet. ed. 3, 55. 1925) recognized Brândzǎ's species but apparently in much too wide a sense, including a yellow form later described as P. superbum by Hagelstein (q.v.). Hagelstein (Mycet. N. A. 66. 1944) says the white forms described by Brândzǎ represent a phase of P. cinereum. Neither the Lister nor the Brândzǎ illustrations cited seem to agree with this conclusion, although a specimen from New York, Hagelstein 3273, referred to this species, has very angular nodes and spores 8–10 μ in diameter and does appear to be a more than usually plasmodiocarpous fruiting of P. cinereum. Brândzǎ emphasizes the small rounded nodes and the small, violaceous spores. We have no specimens which agree adequately with his description, hence do not illustrate the species. It is possible that careful examination of a large series of specimens referred to P. cinereum might reveal such.

Physarum spinulosum Thind & Sehgal, Mycologia 56: 561. 1964.

FIG. 291 *Plate* XXXII Sporangiate, chalk-white, sessile, depressed-globose, subglobose or angular from compression, densely aggregated, often forming a pseudoaethalium, (0.3–)0.4–0.7 (–0.8) mm in diameter; peridium double, the outer peridium calcareous, thick, crustose, smooth, fragile, Diderma-like, the inner peridium remote, membranous, gray; dehiscence irregular, beginning above; hypothallus not evident; columella lacking; capillitium abundant, the nodes numerous, white, calcareous, spherical to irregular in shape and irregular in size, connected by usually short, delicate, hyaline, slender internodes; spores globose to subglobose, varying to elliptical or ovate, black in mass, very dark brown under the lens, prominently and conspicuously spinulose, the spines 1–1.4 μ long, 12–15 μ in diameter when globose, including the spines, correspondingly longer and narrower when elliptical. Plasmodium unknown.

TYPE LOCALITY: Darjeeling, India. HABITAT: On bark and mosses.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATION: Mycologia 56: 562. f. 1.

This species is very close to *P. tessellatum* from which it differs chiefly in the very dark spinulose spores, and to a less significant extent in the apparently more pulvinate sporangia and the less conspicuous common crust over the clusters. It has a superficial resemblance to some forms of *P. diderma* but differs in the large spiny spores and lack of a pseudocolumella. The minor variations from the original description as given here are based on examination of a syntype.

Physarum stellatum (Massee) Martin, Mycologia 39: 461. 1947.

Tilmadoche columbina Rost., Mon. App. 13. 1876.

Tilmadoche compacta Wingate, Proc. Acad. Phila. 41: 48. 1889.

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FIG. 292

Plate XXXII

Lepidoderma stellatum Massee, ex Cooke, Grevillea 17: 60. 1889.

Didymium barteri Massee, Mon. 231. 1892.

Physarum compactum (Wing.) A. Lister, Mycet. 44. 1894. Not P. compactum Ehrenb., 1818.

Physarum columbinum (Rost.) Sturgis, Mycologia 8: 201. 1916. Not P. columbinum Pers., 1795.

Physarum wingatense Macbr., N. Am. Slime-Moulds ed. 2. 72. 1922.

Sporangia globose or depressed, 0.4–0.6 mm in diameter, stipitate, gregarious, sometimes closely so, erect or nodding, usually umbilicate below, gray, brownish gray, or bronze, depending upon the amount of line present, peridium thin, metallic, with limy scales on surface, splitting at maturity in floriform fashion into 6–12 segments; stalk calcareous, white or yellowish, often shading to fuscous or black below, rather long, tapering upward; hypothallus inconspicuous; capillitium delicate, white or colorless, the nodes mostly massed in the center, forming a pseudocolumella, the remaining nodes few, small, oval or subfusiform, with many junctions of the net limeless; spores brown in mass, pale violet-brown by transmitted light, minutely punctate, 8–10 μ in diameter. Plasmodium light gray.

TYPE LOCALITY: Venezuela.

HABITAT: Dead wood and bark.

DISTRIBUTION: Widely distributed in North and South America; Africa; Asia; Indonesia; Philippines.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 26; Hattori, Myxom. Nasu pl. 6, f. 6.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2087, 3499; Thaxter, Rel. Farl. 814.

Because of its limy stem, this species suggests *P. globuliferum* in the field when unopened, but is distinguished by the central limy mass in the sporangium taking the place of a columella. From *P. nucleatum* it may be distinguished by its calcareous stem, and more delicate capillitium, with rounded or subfusiform nodes sparsely borne in the outer portion. There is great variation in the amount of lime on the peridium; less so in that of the stalk, but in some collections the stalks are nearly limeless below and then darker. The length of the stalks varies from about the diameter of the peridium to as much as four fifths of the total height; in most collections it is relatively long. The sporangia are usually erect, but in some specimens they are consistently nodding on the coiled and attenuate tip of the stalk.

Physarum straminipes A. Lister, Jour. Bot. 36: 163. 1898.

Sporangia grayish white, subglobose, obovoid or wedge-shaped, 0.5–1 mm in diameter or, when elongated, 1.5 mm laterally, clustered or scattered, stipitate or sessile, the stalked forms attaining 2 mm or more in total height; stalks, when present, slender, white or pale ochraceous, or translucent, often branched, merging into the reticulate hypothallus of which they are extensions; peridium double, grayish white above, with scattered flakes of lime, the outer layer limy, persising below as a white or ochraceous, poorly defined cup, the inner layer membranous, hyaline, delicate, dehiscing at apex; capillitium dense, rigid, persistent, the nodes numerous, white, rounded or lobed, sometimes massed in the center and forming a loose pseudocolumella; spores black in mass, dark yellowish brown by transmitted light, prominently warted, with larger warts grouped in clusters, 10– $11~\mu$ in diameter. Plasmodium white.

FIG. 293 Plate XXXII TYPE LOCALITY: Dunstable, England.

HABITAT: Dead leaves and straw.

DISTRIBUTION: Great Britain, Ireland, France, Germany; Oregon; Chile; New Zealand.

ILLUSTRATIONS: Jour. Bot. 36, pl. 386, f. 2; Lister, Mycet. ed. 3, pl. 42.

The weak, often branched, stalks, clearly extensions of the hypothallus, the clustered sporangia with dense, persistent capillitium and the spores with the very prominent clusters of warts are the distinctive characters of this species. The outer peridium is very delicate above and breaks away early, exposing the inner peridium which looks gray because of the dark spores within; below it is thicker and more or less cup-like.

FIG. 294 Plate XXXII Physarum sulphureum Alb. & Schw., Consp. Fung. 93. 1805.

Physarum flavum Fries, Symb. Gast. 22. 1818.

Craterium flavum (Fries) Fries, Summa Veg. Scand. 454. 1849.

Physarum lepidodermoides A. Blytt, Forh. Vid.-Selsk. Christiania 1892(2): 4. 1892.

Physarum variabile Rex, Proc. Acad. Phila. 45: 371. 1893.

Sporangia gregarious, stipitate, substipitate, or sessile. 0.4–0.6 mm in diameter, total height up to 1 mm, regularly or irregularly globose, ellipsoid, obovate, or cylindric-clavate, occasionally plasmodiocarpous, pale ochraceous or dingy yellow to olivaceous brown; peridium varying from thick, crustaceous, and rugulose to thin and translucent, rupturing irregularly; stalk, when present, short, stout, calcareous, usually expanded at the base, longitudinally rugose, dingy white to ochraceous or grayish brown; capillitium lax, the nodes variable but mostly large, angular, white or yellowish, often aggregated at the center; spores black in mass, dark brown by transmitted light, minutely but distinctly warted, the warts sometimes in lines, 9–11 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Germany.

HABITAT: Dead leaves and wood.

DISTRIBUTION: Scandinavia, central and southeastern Europe; southern Canada and the United States; Puerto Rico; South America; Sierra Leone.

ILLUSTRATIONS: Alb. & Schw., Consp. Fung. pl. 6, f. 1; Lister, Mycet. ed. 3. pl. 21, 65; Hattori, Myxom. Nasu pl. 18, f. 1; Hagelst., Mycet. N. Am. pl. 7, f. 2.

EXSICCATI: Jaap, Myxom. Exs. 24; Brândză, Myx. Roum. 29, 30 (IA).

The yellow colors are dull and often scarcely apparent in the paler forms and obscured in the darker. The crustose peridium, with the large nodes exposed quickly as the spores are shed, the stout calcareous stalk or base, and the strong tendency to develop prolate or subcylindrical sporangia are the usual marks of this rather rare species.

FIG. 295 Plate XXXIII Physarum superbum Hagelst., Mycologia 32: 385. 1944.

Physarum aureum Brândză, Bull. Soc. Myc. Fr. 44: 261. 1929, in part. Not P. aureum Pers., 1794.

Primarily plasmodiocarpous, terete, or slightly compressed laterally, and often with many sporangia intermingled with the plasmodiocarps, 0.4–0.6 mm

in diameter, bright ochraceous yellow to orange or orange-brown, rarely dull gray, the lower portion often nearly limeless; sporangia sessile, globose to pulvinate merging by continuous stages into the branched and netted plasmodiocarps, these often becoming somewhat laterally compressed; peridium double, the outer layer limy, rugulose, usually forming a continuous crust above but often scantier and broken into flakes below, the inner layer closely appressed, delicate, membranous, hyaline, dehiscing in the plasmodiocarpous forms by a longitudinal fissure; capillitium well-developed, persistent, the nodes pallid to yellow, mostly large, angular, the connecting nodes hyaline or yellowish, branched; spores black in mass, pale violaceous brown by transmitted light, minutely punctate, 8–10 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Philadelphia, Pennsylvania.

HABITAT: Dead leaves, mosses, and decaying wood.

DISTRIBUTION: New York to Ontario, south to Florida and Kansas; Europe; India; Japan.

ILLUSTRATIONS: Bull. Soc. Myc. Fr. 44: pl. 16; Lister, Mycet. ed. 3. pl. 22, a (as Physarum sessile).

Hagelstein (1944, p. 65) lists Physarum variabile Rex. var. sessile A. Lister as in part a synonym, P. sessile Brândză and P. aureum Brândză as included in P. superbum. The two latter names appear to have been applied to a mixture of several species, varying in color from golden yellow to white and also varying in habit and spore characters. It seems best to regard them as names of uncertain application. P. aureum Brândză is, in any event, a later homonym of P. aureum Pers. P. superbum Hagelst., as here limited, is fairly clearly defined. Hagelstein based his species on a specimen collected by Bilgram in Aug.—Sept., 1900, part of which was sent to A. Lister and was illustrated in Mycet. ed. 2, pl. 22, a (also in ed. 3. under the same number, as cited). In the Iowa collection there is a box from Bilgram with the same label, which includes three species, P. superbum, P. serpula and P. bogoriense. This may explain, in part, the confusion in Lister's treatment. Another specimen from Bilgram, also from Pennsylvania, Haverford, 1 Sept. 1900, determined as Badhamia decipiens, possibly by Macbride, represents the present species.

The relationship of *P. superbum* is with *P. lateritium*, from which it differs in the more yellowish color and the large angular nodes, paler in color and without any suggestion of red centers.

P. sessile, when properly delimited, may prove to be useful when applied to a group of subplasmodiocarpous collections now commonly filed under P. cinereum and P. vernum.

Physarum tenerum Rex, Proc. Acad. Phila. 42: 192. 1890.

Physarum maculatum Macbr., Bull. Nat. Hist. Univ. Iowa 2: 383. 1893.

Sporangia gregarious, stipitate, spherical, erect or nodding, small, 0.3–0.4 mm in diameter, total height 1–3 mm, peridium single, membranous but thickly studded with circular, flattened, yellow, greenish yellow, ochraceous gray or nearly white flakes of lime, dehiscing by petal-like lobes; stalk 0.7–2.5 mm long, subulate, slender, calcareous, opaque, pale yellow above, often shading to darker below; columella none, but base of peridium often thickened forming an apical disk on the stem; capillitium delicate, the nodes yellow, small, rounded, connected by hyaline threads, many of the junctions often limeless; spores black in mass, violaceous by transmitted light, very minutely warted, 8–11 μ in diameter. Plasmodium yellow or yellowish green.

FIG. 296
Plate XXXIII

TYPE LOCALITY: Philadelphia, Pennsylvania.

HABITAT: Dead wood.
DISTRIBUTION: Cosmopolitan.

ILLUSTRATION: Lister, Mycet. ed. 3. pl. 25. EXSICCATI: Ellis & Ev., N. Am. Fungi 2489.

The small, globose sporangia on slender calcareous stalks, with delicate capillitium and small rounded nodes, and without columella, are the marks of this species. Some collections are quite yellow; others are so pale as to appear almost white. There is considerable variation in the amount of lime in the stems, but those of all specimens examined are limy at least in part; many noticeably so.

The type specimen of P. maculatum is a robust form with very limy stem and rather large spores, $10-11~\mu$ in diameter, bearing the clusters of larger warts described by Macbride. It may be a distinct species, but pending further information it is best regarded as an extreme phase of P. tenerum.

Physarum tessellatum Martin & Farr, Lloydia 22: 300. 1960.

FIG. 297 Plate XXXIII Sporangiate, sessile, sporangia flattened, approximately isodiametric, 0.5–1.2 mm, closely appressed and angular from pressure, almost forming a pseudoaethalium, pure white; peridium double, the outer peridium densely encrusted with minute lime granules, closely applied to the delicate, transparent inner peridium but flaking away readily; the outer peridia of adjoining sporangia in contact and forming a tesselate crust over the group of sporangia, the basal portion tending to persist as a cup; capillitium dense, the lime knots mostly small, rounded, but with some large and compound, connected by short, hyaline tubules, these with numerous limeless expansions; spores black in mass, dark brown by transmitted light, closely and prominently warted, with the warts sometimes in lines, globose or somewhat irregular in shape, (11–) 12–14(–15) μ in diameter; hypothallus limy. Plasmodium unknown.

TYPE LOCALITY: St. Paul's River, Liberia.

навітат: Dead leaves.

DISTRIBUTION: Known only from type locality. ILLUSTRATIONS: Lloydia 22: 297, f. 1, 2; 299, f. 3.

This species is closely related to *P. spinulosum*, as noted under that species, differing in its warted, not spinulose spores, in its more flattened sporangia covered by a common crust, and in the persistent cupulate base. This is pale gray and almost vitreous in the type collection, ochraceous and duller in Cook's second collection gathered a year later. Only additional collections of both species can determine whether they should be united.

Physarum tropicale Macbr., N. Am. Slime-Moulds 45. 1899.

FIG. 298 Plate XXXIII Sporangia scattered, gregarious, subglobose or turbinate, stipitate or sessile on a narrowed base, 0.6–1 mm in diameter, total height up to 1.2 mm, iridescent bluish green above, covered with a sprinkling of white lime flakes, brown below, nearly limeless; peridium delicate, membranous, iridescent above, the lower portion sharply delimited, thicker, tending to persist as a cup-like base; stalk thick, stout, dark brown, cylindrical, not calcareous, not exceeding diameter of sporangium, often less, sometimes lacking; columella lacking; capillitium dense, the nodes small, white, angular, uniformly distributed; spores

black in mass, dark violaceous brown by transmitted light, minutely but closely and distinctly warted, 11–12 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Mexico, probably Jalapa.

навітат: Rotten wood.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATION: N. Am. Slime-Moulds, pl. 15, f. 4 (same ref. for ed. 2.)

G. Lister, Mycet. ed. 2. 72. 1911, reduced this to synonymy with *P. connatum* A. Lister, never a legitimate name and now broken up, with *P. notabile* Macbr. as its principal element. Hagelstein, 1944, p. 60, cites it as a doubtful synonym of that species. Martin, 1949, p. 126, expressed the opinion that the species is valid. The type is scanty but in good condition. Reexamination seems to justify reinstating it among recognized species. The turbinate sporangium with the iridescent upper portion and persistent, thickened, cup-like base, the character of the capillitium, the thick, brown stalk and the distinctly warted and purplish spores are quite different from any specimen of *P. notabile* examined.

As Macbride noted, the prominent cup might easily justify referring this species to *Craterium*, but in all other respects it suggests *Physarum*. Until more material is found, nothing would be gained by proposing a new combination in that genus.

Macbride states that the specimen was sent to him by C. L. Smith from Mexico. As most of the specimens sent by Smith were from Jalapa, it seems likely that that city or the nearby forest was where this specimen originated.

Physarum variegatum Thind & Dillon, Mycologia 59: 464. 1967.

Fructifications gregarious, primarily plasmodiocarpous, varying to sporangiate, deep reddish orange, sessile on a constricted base; plasmodiocarps short, simple or sparsely branched, terete or slightly compressed laterally, up to 2.2 mm long and 0.8 mm wide, sporangia globose or pulvinate, attaining 0.9 mm in longest dimension; peridium compound, the outer layer calcareous, deep reddish orange, tending to crack into angular patches and exposing the bright orange calcareous under portion, giving the fructifications a variegated aspect, inner layer dark, membranous, not remote, enclosing the spore mass; dehiscence by irregular cleavage of the upper portion; capillitium abundant, the nodes orange, tending to fade to yellow or pallid, rounded to angular, connected by slender, hyaline tubules; spores blackish brown in mass, dark yellow-brown by transmitted light, globose to elliptical or ovate, warted, the warts varying in size and sometimes arranged in lines forming an incomplete reticulate pattern, (9-)10-12(-14) μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Darjeeling, India.

HABITAT: Decayed wood.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATION: Mycologia 59: 465, f. 2.

This species appears to be closely related to *P. superbum*, from which it differs in its darker color, wider and shorter plasmodiocarps, and its larger, darker and more conspicuously warted spores. It is difficult to say, on the basis of a portion of the type, whether the peridium should be regarded as double or triple. The deep orange outer layer and the bright orange inner portion are so closely connected as to seem to form a single layer, with the surface darker than the inner portion.

fig. 299 Plate XXXIII Physarum vernum Somm., in Fries, Syst. Myc. 3: 146. 1829.

Badhamia verna (Somm.) Rost., Mon. 145. 1874.

Sporangiate, sessile, globose, varying to plasmodiocarpous, (0.3–)0.5–0.8(–1) mm in diameter, the plasmodiocarps usually short, simple, or branched, but sometimes several mm long, often crowded, grayish white, rugulose; peridium single, membranous, usually densely covered with coarse, closely set calcareous granules, rarely nearly limeless; capillitium of large, angular, branching, limy nodes connected by short, hyaline tubules, the nodes sometimes massed in the center to form a pseudocolumella; spores black in mass, dark purplish brown by transmitted light, warted, (9–)10–12 μ in diameter. Plasmodium white.

TYPE LOCALITY: Norway, vicinity of Oslo.

HABITAT: Dead leaves, twigs and stems of herbaceous plants, rarely on wood.

DISTRIBUTION: Norway, Sweden, Great Britain, Austria, Portugal; South Africa; India; Japan; Hawaii; South Australia, New Zealand; Mexico, Cuba; possibly Canada and the United States.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 48; Hattori, Myxom. Nasu pl. 19, f. 2.

EXSICCATUS: Jaap, Myxom. Exs. 123.

The variety *iridescens* G. Lister, Guide Brit. Mycet. ed. 4. 25. 1919, was based upon a phase with limeless peridium and large, dark spores, otherwise close to *P. cinereum*. Since limeless phases are not uncommon in this as in other calcareous species and often occur in the same fruitings with the usual calcareous phases, this name seems unnecessary.

As noted by several authors, this species is closely related to *P. cinereum*, from which it is distinguished by its more limy and crustose peridium, greater tendency to fruit as plasmodiocarps, and somewhat larger and darker spores. The original description does not make this clear, and the present treatment is based upon what the name has come to signify in the last half century. Rostafinski, as noted above, transferred the species to *Badhamia*; the short and often scanty tubules make this understandable. A. Lister, Mycet. 34. 1894, made it a synonym of *B. panicea*. G. Lister, Mycet. ed. 2. 38. 1911, modified this by listing Rostafinski's species as only in part a synonym of *B. panicea*, and recognized *P. vernum* as a distinct entity on p. 75 of the same work. This is essentially the current treatment. See Lister monograph, ed. 2. 170. 1911, footnote, reprinted in ed. 3. 162. 1925.

We have specimens from scattered localities ranging from Maine to Ontario, south to New York and Ohio, and from California, which are provisionally assigned to this species. None of them agrees completely with the European material, and some seem to be very limy specimens of *P. cinereum*. Others, however, agree more nearly with the description as given.

Physarum styriacum Gottsb., Nova Hedwigia 12: 245. 1966, differs from P. vernum mainly in its extremely large spores, (17-)18-20(-22) μ in diameter when spherical, or sometimes ovate and correspondingly longer and narrower. It is known thus far only from a single alpine collection, but may well prove to be constant and distinct.

Physarum virescens Ditmar, in Sturm, Deuts. Fl. Pilze 1: 123. 1817.

FIG. 300 Plate XXXIII Physarum thejoteum Fries, Symb. Gast. 21. 1818.

Physarum caespitosum Schw., Trans. Am. Phil. Soc. II. 4: 258. 1832.

Didymium nectriaeforme Berk. & Curt., Grevillea 2: 65. 1873.

Physarum ditmari Rost., Mon. App. 8. 1876.

Didymium sinapium Cooke, Myxom. Gr. Brit. 33. 1877.

Sporangia sessile or with weak, strand-like stalks, spherical, ovoid, or elongate, 0.2–0.4 mm in diameter, crowded or superimposed in small clusters, yellow, greenish yellow, or pallid gray-green; peridium thin, fragile, rugose; capillitium delicate, the nodes small, irregular, yellow or yellowish; columella none; spores dingy brownish black in mass, pale violaceous gray by transmitted light, minutely punctate, 8–10 μ in diameter. Plasmodium lemon-yellow.

TYPE LOCALITY: Germany.

HABITAT: Moss and dead leaves.

DISTRIBUTION: Europe; temperate North America; India, Java, Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 61, a-c; Jour. Ind. Bot. Soc. 34: 87. f. 2, a-i; Macbr. & Martin, Myxom. pl. 3, f. 49, 50; Hattori, Myxom. Nasu pl. 19, f. 1.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2692; Hintikka, Myxogast. Fenn. 16; Brândză, Myxom. Roum. II. 1: 7(NY); 16(IA); Jaap, Myxom. Exs. 6.

The Lister monograph recognized two varieties. The var. obscurum A. Lister, Mycet. 59. 1894, with spores $6-8~\mu$ in diameter, seems out of place here, but we have seen no examples; it is possible that it is a phase of P. digitatum. The var. nitens A. Lister, Mycet. 59. 1894, is here regarded as the same as P. luteolum Peck, as suggested by Hagelstein, Mycet. N. Am. 77. 1934, who restricts P. virescens to "the small, heaped, yellow or greenish yellow sporangia of irregular shape." As so restricted the species seems little more than a color phase of P. confertum. Also, it is impossible to place the grayish forms with little or no trace of yellow anywhere but here, so the yellow peridium cannot be regarded as constant. Even in such forms the capillitium may be yellow under the microscope.

Physarum viride (Bull.) Pers., Ann. Bot. Usteri 15: 6. 1795.

Sphaerocarpus aurantius Bull., Hist. Champ. Fr. 133. 1791.

Sphaerocarpus viridis Bull., Hist. Champ. Fr. 135. 1791.

Sphaerocarpus luteus Bull., Hist. Champ. Fr. 136. 1791.

Stemonitis aurantia (Bull.) J. F. Gmel., Syst. Nat. 2: 1469. 1791.

Stemonitis viridis (Bull.) J. F. Gmel., Syst. Nat. 2: 1469. 1791.

Stemonitis bicolor J. F. Gmel., Syst. Nat. 2: 1469. 1791.

Physarum aureum Pers., Neues Mag. Bot. 1: 88. 1794.

Physarum luteum (Bull.) Pers., Syn. Fung. 172. 1801.

Physarum aurantium (Bull.) Pers., Syn. Fung. 173. 1801.

Trichia lutea (Bull.) DC., Fl. Fr. 2: 255. 1805. Not T. lutea Trent., 1797.

Trichia viridis (Bull.) DC., Fl. Fr. 2: 255. 1805.

Trichia aurantia (Bull.) DC., Fl. Fr. 2: 255. 1805.

Physarum nutans var. viride (Bull.) Fries, Syst. Myc. 3: 129. 1829.

Physarum nutans var. aureum (Pers.) Fries, Syst. Myc. 3: 129. 1829.

Physarum nutans var. coccineum Fries, Syst. Myc. 3: 129. 1829.

Tilmadoche mutabilis Rost., Mon. 129. 1874.

Tilmadoche viridis (Bull.) Sacc., Michelia 2: 263. 1881.

Chondrioderma exiguum Racib., Hedwigia 28. 119. 1889.

Sporangia stalked, gregarious, nodding, lenticular or subglobose, umbilicate below, yellow, greenish yellow, greenish gray, or golden to reddish orange, often fading, 0.3–0.6 mm in diameter, up to 1.5 mm in total height; peridium delicate, incrusted with calcareous flakes, splitting into irregular

FIG. 301 Plate XXXIII fragments above and floriform lobes below; capillitium dense, the nodes tending to be fusiform, orange or yellow, connected by hyaline threads; stalk subulate, varying from pale yellow or reddish and darker below to nearly black, usually relatively long; spores fuscous or violaceous black in mass, bright violet by transmitted light, nearly smooth, 7–9 μ in diameter. Plasmodium yellow or greenish yellow.

TYPE LOCALITY: France.

HABITAT: Dead wood, bark, old sporophores of fungi, and less commonly leaves and herbaceous debris.

DISTRIBUTION: Cosmopolitan.

illustrations: Bull., Herb. Fr. pl. 407, f. 1, 2; pl. 484, f. 2; Lister, Mycet. ed. 3. pl. 31; Nat. Geogr. Mag. 49(4): pl. 16; Macbr. & Martin, Myxom. pl. 6, f. 127, 128; Hattori, Myxom. Nasu pl. 19, f. 3.

EXSICCATI: Jaap, Myxom. Exs. 23, 65, 164; Brândză, Myxom. Roum. II. 1: 4,5; III. 1: 5(NY); 13, 14(IA); Thaxter, Rel. Farl. 417.

An extremely common and widely distributed species, varying in color from dingy white or pale yellow to orange-red. Old specimens may fade to nearly white and then may easily be confused with *P. nutans*. The nodes, however, usually retain their color and the general habit of the species, while similar to that of *P. nutans*, is more slender and graceful. The more globose sporangia usually suggest rapid maturation. There is considerable variation in the length of the stalk; while in most specimens it is rather long and attenuated and twisted at the apex, it may be very short and the sporangia may appear nearly sessile. The varieties aurantium A. Lister, Mycet. 47. 1894, incanum A. Lister, l.c., and hinnuleum G. Lister, Jour. Bot. 52: 17. 1924, are all based mainly on color variations, which merge completely. The var. bethelii Sturgis, was regarded by Macbride as a distinct species and is so treated here.

Some collections referred to *P. flavicomum* on the basis of the sooty appearance, correlated with sparsity of lime in the peridium, have discoid sporangia and elongate nodes and are certainly very close to *P. viride* (Henney, 1966).

Ellis, N. Am. Fungi 1213, as *Tilmadoche mutabilis* Rost., often cited as representing *P. viride*, appears to be an old, weathered form of *P. nutans*. Our specimen of this set is very poor, but a better one, sent by Wingate to Farlow as a duplicate of this number, and by Farlow to Macbride, confirms this opinion.

EXCLUDED AND DOUBTFUL SPECIES

"Physarum albopunctatum Link Herb."

Cited by Rost. Mon. 101. 1874, as synonym of *P. leucopus* Link, "p.p.," p. 114, as synonym of *P. leucophaeum* Fries. Not validly published.

Physarum album Fuckel, F. Rhen. No. 1459 (with descr.?). 1865.

Fuckel, Jahrb. Nass. Ver. Nat. 23–24: 340. 1870, cites it as a synonym of *Carcerina spumarioides* (Fries) Fries; Rost. Mon. 102. 1874, cites it as a synonym of *P. cinereum*.

"Physarum alutaceum Wallr. Herb."

Cited by Rost., Mon. 142. 1874, as synonym of *Badhamia utricularis*. Not validly published.

Physarum antiades (Bull.) Fries, Syst. Myc. 3: 135. 1829.

Based on Sphaerocarpus antiades Bull., Hist. Champ. Fr. 127. 1791 (pl. 368, f. II). Probably a Physarum, but not recognizable specifically.

Physarum asiaticum Skvortz., Philipp. Jour. Sci. 45: 87. 1931.

Close to, possibly identical with, *P. confertum*.

Physarum atrum Fries, Syst. Myc. 3: 147. 1829.

Not *P. atrum* Schw., 1832. According to Morgan, Jour. Cinc. Soc. Nat. Hist. 19: 27. 1896, *P. atrum* Fries, is not a myxomycete. See Cooke, Myxom. Gr.

Brit. 16. 1877, and Berlese, in Sacc., Syll. Fung. 7: 350, 351. 1888. The comment "doubtful" in G. Lister, Mycet. ed. 3. 260. 1925, summarizes adequately the unsatisfactory status of Fries's name.

"Physarum aureum Fries," Summa Veg. Scand. 453. 1849, ex Berlese, in Sacc., Svll. 7: 360. 1888.

Not valid. Fries cited Persoon.

"Physarum auriscalpium Macbr.," Bull. Lab. Nat. Hist. Iowa 2: 158. 1893.

Cited in A. Lister, Mycet. 59. 1894, as synonym of *P. virescens*; by G. Lister, Mycet. ed. 2. 84. 1911, as of *P. virescens* var. *nitens* A. Lister. Macbride cited Cooke as author.

Physarum bryophilum Fries, Syst. Myc. 3: 135. 1829.

Cited by Rost., Mon. 204. 1874, as synonym of Lamproderma columbinum; "p.p." in index.

"Physarum canum Klotzsch," in Hook. Herb., ex Rost., Mon. App. 6. 1876.

Not validly published.

Physarum chlorinum Cooke, Grevillea 5: 101. 1877.

The description might apply to P. viride.

"Physarum chrysocephalum Wallr. Herb."

Cited by Rost., Mon. 98. 1874, as synonym of *Physarum schumacheri* Spreng. No evidence of valid publication.

Physarum chrysotrichum Berk. & Curt., Grevillea 2: 66. 1873.

Cited by Berl., in Sacc., Syll. 7: 333. 1888, as syn. of Badhamia decipiens (Curt.) Berk. There is no "P. chrysotrichum Massee," as cited in all three editions of Lister's Mycetozoa. See P. subglobosum.

Physarum cinerascens Schum., Enum. Pl. Saell. 2: 199. 1803.

Cited by Rost., Mon. 154. 1874, as synonym of *Didymium farinaceum* Schrad.; *D. melanospermum* of the present treatment.

"Physarum cinereum Schum." Herb. ex Rost., Mon. 127. 1874.

Cited as synonym of *Tilmadoche nutans*. Not *P. cinereum* (Batsch) Pers. Not validly published.

"Physarum clavus Ehrenb., Herb." ex Rost., Mon. 114. 1874. Not P. clavus Alb. & Schw.

Not validly published.

Physarum coccineum Fries, Summa Veg. Scand. 453. 1849.

Based on *P. nutans* var. coccineum Fries, Syst. Myc. 3: 129. 1829; cited in the Summa as a synonym of *P. aureum*; by Rost., Mon. 130. 1874, of *P. mutabile*. Validity of Fries's binomial doubtful.

"Physarum coelatum Ehrenb. Herb." ex Rost., Mon. 102. 1874.

Cited as a synonym of P. cinereum. Not validly published.

"Physarum coerulescens Pers." in litt., an Desmazières.

Cited by Rost., Mon. 142. 1874, as synonym of Badhamia utricularis. Not validly published.

"Physarum confluens Fuckel," Jahrb. Nass. Ver. Nat. 23-24: 342. 1870.

Cited by Rost., Mon. 151. 1874, as synonym of *Didymium complanatum*. Fuckel cited his specimen as *P. confluens* Pers., Syn. Fung. 169. 1801.

Physarum connatum Schum., Enum. Pl. Saell. 2: 202. 1803.

Noted as doubtful by Rost., Mon. 381. 1875, and by later authors. If validly published, it is an earlier homonym of *P. connatum* Dittm. 1817.

"Physarum corrugatum Link, Herb."

Cited by Rost., Mon. 102. 1874, as synonym of *P. cinereum*; "p.p." in index. Not validly published.

Physarum crustiforme Speg., Ann. Mus. Nac. Buenos Aires 6: 100. 1899.

Doubtful; G. Lister, Mycet. ed. 3, 260, 1925.

"Physarum curtisii Berk.," Grevillea 2: 65. 1873.

Cited by Berlese, in Sacc., Syll. 7: 334. 1888. An error. Berkeley referred his species to *Didymium*.

"Physarum diderma Macbr.," N. Am. Slime-Moulds, ed. 2. 55. 1922.

Cited by Lister, Mycet. ed. 3. 60. 1925, as a synonym of *Diderma testaceum*. Macbride wrote *P. diderma* Rost.

Physarum didymium Schum., Enum. Pl. Saell. 2: 202. 1803.

Cited by Rost., Mon. 127. 1874, as synonym of *Tilmadoche nutans* (Pers.) Rost., "p.p." in index.

"Physarum difforme Link."

Cited by Rost., Mon. 177. 1874, as "Diss. I . . . p. 27." Reference is to Ges. Nat. Fr. Berlin Mag. 3: 27. 1809, but no such combination appears there, nevertheless, the name is cited by Berlese, Massee and the Listers, evidently on the basis of Rostafinski's reference, as a synonym of what is now called Didymium difforme.

"Physarum durieui Mont. Herb."

Cited by Rost., Mon. 125. 1874, as synonym of Craterium aureum. Not validly published.

"Physarum effusum Link, Herb,"

Cited by Rost., Mon. 95. 1875, as synonym of *P. lividum* Rost. Not validly published. Not *P. effusum* Schw., 1822.

Physarum elegans Schw., Trans. Am. Phil. Soc. II. 4: 257. 1832.

Rostafinski, Mon. 115. 1874, suggests that it may be a *Badhamia*. Both Berlese and Massee recognize it under *Physarum* but add nothing to the original description. It is rejected as doubtful in the second and third editions of the Lister monograph. The type should be studied.

Physarum elongatum Link, Ges. Nat. Fr. Berlin Mag. 7: 42. 1815. Doubtful; Rost., Mon. 381. 1875.

Physarum fasciculatum Jungh., Crypt. Java 11. 1838.

The basionym of *Badhamia fasciculata* (Jungh.) Rost., Mon. App. 2. 1876. Both cited by G. Lister, Mycet. ed. 3. 52. 1925, as doubtful synonyms of *P. reniforme* G. Lister.

Physarum fimetarium Schum., Enum. Pl. Saell. 2: 205. 1803.Doubtful; Rost., Mon. 381. 1875.

"Physarum flavicomum Sacc."

Cited by Massee, Mon. 285. 1892, as synonym of *P. cupripes* Berk. & Rav. Berlese, in Sacc., Syll. 7: 345, cites Berkeley as the author.

Physarum flavovirens Alb. & Schw., Consp. Fung. 97. 1805.

As noted by Fries, Syst. Myc. 3: 137. 1829, this is a "species dubie proposita," published as an addition to *P. clavus*. It was regarded as doubtful by Rostafinski and others, including G. Lister, Mycet. ed. 3. 260. 1925.

"Physarum flavum Fuckel," Jahrb. Nass. Ver. Nat. 23-24: 343. 1870.

Cited by Rost., Mon. 99. 1874, as a synonym of *P. schumacheri* Spreng., and copied by later authors, but Fuckel correctly cited Fries as the author of the combination.

Physarum fulgens Pat., Bull. Soc. Myc. Fr. 8: 122. 1892.

Possible synonym of P. lateritium, G. Lister, Mycet. ed. 3. 63. 1925.

Physarum globosum Schum., Enum. Pl. Saell. 2: 199, 1803.

Doubtful. See Rost. Mon. 154. 1874; G. Lister, Mycet. ed. 2. 129, 1911, and ed. 3. 47, 115. 1925.

Physarum globosum Somm., Suppl. Fl. Lapp. 243. 1826. n. v.

Cited by Rost., Mon. 128. 1874, as synonym of *Tilmadoche gracilenta* (Fries) Rost. May not have been published as new. If it was, it is a later homonym of *P. globosum* Schum.

"Physarum globuliferum DC., Herb!. teste Fries."

Cited by Rost., Mon. 140. 1874, as synonym of *Badhamia hyalina*. Not validly published. Not *P. globuliferum* (Bull.) Pers., 1801.

"Physarum gracile Wein., Herb!"

Cited by Rost., Mon. 140. 1874, as synonym of *Badhamia hyalina*. Not validly published.

"Physarum gracilentum Fuckel."

Cited by Rost., Mon. 140. 1874, as synonym of *Badhamia hyalina*. Fuckel, Jahrb. Nass. Ver. Nat. 23-24: 342. 1870, wrote *P. gracilentum* Fries.

Physarum griseum Link, Ges. Nat. Berlin Mag. 3: 27. 1809.

Variously cited as a synonym of P. didermoides, P. compressum and P. cinereum. Perhaps the last. See Fries, Syst. Myc. 3: 126. 1829.

Physarum griseum Skvortz., Philipp. Jour. Sci. 45: 86. 1931.

A later homonym of P. griseum Link. Identity uncertain.

"Physarum gyrosum Massee"

Cited by A. Lister, Mycet. 33, 66. 1894, as including both Fuligo septica and Badhamia decipiens. Not validly published. Massee, Mon. 307. 1892, wrote P. gyrosum Rost.

Physarum hypnophilum Fries, Stirp. Femsj. 83. 1826.

Not recognizable from description in Fries, Syst. Myc. 3: 140. 1829.

Physarum hypnorum Link, Ges. Nat. Fr. Berlin Mag. 7: 43. 1815.

Cited by Rost., Mon. 113. 1874, as synonym of *Physarum leucophaeum*. Rostafinski cites Link's 1809 paper incorrectly.

Physarum leucostictum Chev., Fl. Par. 1: 336. 1826.

Cited by Rost., Mon. 123. 1874, as synonym of Craterium leucocephalum; "p.p." in index.

Physarum luteovalve Schw., Proc. Am. Phil. Soc. II. 4: 257. 1832.

Not recognizable from description.

Physarum mandschurica Skvortz., Philipp. Jour. Sci. 45: 87. 1931.

Apparently close to *P. flavicomum*, but differing in rugose, white peridium and large, dark reddish spores, $11-12~\mu$ in diameter. This may well be a distinct species.

Physarum melaleucum Nyl., Not. Sällsk. Faun. Fl. 4: 126. 1859.

Cited by Rost., Mon. 142. 1874, as synonym of Badhamia capsulifera; "p.p." in index.

Physarum melanopus Fries, Symb. Gast. 25. 1818.

Cited by Rost., Mon. 155. 1874, as synonym of *Didymium farinaceum* Schrad.; "p.p." in index. Cited by Fries, Syst. Myc. 3: 114. 1829 by implication only.

"Physarum membranaceum Schum. Herb!"

Cited by Rost., Mon. 140. 1874, as synonym of *Badhamia hyalina*. Not validly published.

"Physarum muelleri Berk. msc."

Cited by Rost., Mon. App. 15. 1876. Not validly published. Rostafinski adopted Berkeley's manuscript epithet for *Chrondrioderma muelleri* Rost., l. c., which was validly published, but should be cited as of "Rost.," not "(Berk.) Rost."

Physarum nigrum Fries, Syst. Myc. 3: 146. 1829.

Cited by Rost., Mon. 155. 1874, as synonym of *D. farinaceum* Schrad.; "p.p." in index. Fries, l. c., p. 147, equates it with *Strongilium minus* Fries, Symb. Gast. 9. 1817, incorrectly cited by Berlese, in Sacc. Syll. 381, as "S. *minor*." Possibly a synonym of *Didymium minus* of the present treatment.

"Physarum obrusseum Macbr."

Invalid. Cited by G. Lister in ed. 2 and 3 of the Lister monograph. Macbride, N. Am. Slime-Moulds 52. 1899, wrote *P. obrusseum* (Berk. & Curt.) Rost. *Physarum oxyacanthae* Schum., Enum. Pl. Saell. 2: 199. 1803.

Cited by Rost., Mon. 154. 1874, as synonym of *Didymium farinaceum* Schrad.; "p.p." in index. Doubtful, G. Lister, Mycet. ed. 3. 260. 1925.

Physarum piceum Fries, Syst. Myc. 3: 143, 1829.

Doubtful, Rost. Mon. 383, 1875.

Physarum polonicum Skup., Bull. Intern. Acad. Pol., B. 1924: 391, n.v.

Cited by G. Lister, Mycet. ed. 3. 51. 1925, as synonym of *P. connatum* (Peck) Lister, i. e. *P. notabile* of present treatment. Denied by Skupienski, Bull. Soc. Myc. France 42: 158. 1924. The species is recognized by Krzemieniewska, Sluz. 82. 1960.

Physarum polyaedron Schw., Proc. Phila. Acad. II. 4: 257. 1832.

An ascomycete, Argynna polyhedron (Schw.) Morgan.

Physarum purpurascens Link, Ges. Natur. Fr. Berlin Mag. 7: 42. 1815. Doubtful; Rost. Mon. 383, 1875. Physarum pyriforme Schum., Enum. Pl. Saell. 2: 204. 1803.

Cited by Berlese, in Sacc., Syll. 7: 439. 1888, as synonym of Trichia fallax Pers.

"Physarum ramentaceum Fries, in litteris an Wein. 1836."

Cited by Rost., Mon. 101. 1874, as synonym of *P. leucopus* Link. Reference is to Weinmann, Fl. Ross. 1836, but it is uncertain whether Fries's name was validly published in that work.

Physarum rubiginosum Berk., in Smith, Engl. Fl. 5(2): 315. 1836.

Cited by Rost., Mon. App. 4. 1876, as synonym of *Badhamia dictyospora* Rost., with "non Chev." specifically added. If proposed by Berkeley as new, the name had already been preempted by both Chevallier and Fries.

Physarum salicinum Schum., Enum. Pl. Saell. 2: 200. 1803.

Cited by Rost., Mon. 204. 1874, as synonym of *Lamproderma columbinum*; "p.p." in index. Doubtful; G. Lister, Mycet. ed. 3. 1925.

"Physarum schumacheri Rost.," ex Massee, Mon. 275. 1892.

Rostafinski, Mon. 98. 1874, cited Sprengel as author.

"Physarum sinuosum Wallr.," ex Rost., Mon. 102. 1874.

Cited as synonym of *P. cinereum*. Wallroth, Fl. Crypt. Germ. 349. 1833, cited Fries as author.

Physarum solutum Schum., Enum. Pl. Saell. 2: 204. 1803.

Basionym of *Tilmadoche soluta* (Schum.) Fries, Summa Veg. Scand. 454. 1849. Both doubtful synonyms of *Physarum nutans*.

Physarum sphaeroidale Chev., Fl. Par. 1: 339. 1826.

Cited by G. Lister, Mon. ed. 3. 87. 1925, as a synonym of P. didermoides.

Physarum sphaeroides Chev., Fl. Par. 1: 339. 1826.

Cited by Fries, Syst. Myc. 3: 106. 1829, as a synonym of *Diderma globosum* Pers., with reference to *Reticularia sphaeroidalis* Bull., Hist. Champ. Fr. 94. 1791, pl. 446, f. 2, which suggests that this and the preceding entry refer to the same original. Both must be regarded as doubtful.

Physarum stipitatum Chev., Fl. Par. 1: 339. 1826.

Basionym of *Diderma stipitatum* (Chev.) Fries, Syst. Myc. 3: 104. 1829. Bulliard's pl. 380, f. III, cited by Fries, is suggestive of *Diderma crustaceum*, but G. Lister's comment, doubtful, Mycet. ed. 3. 261. 1925, is warranted.

Physarum striatum Fries, Syst. Myc. 3: 131. 1829.

Described with three varieties, citing several older names. According to Rost., Mon. 130. 1874, one of these is *Physarum viride*. In the index, p. 385, he cites "P. striatum Fuckel" as a synonym of P. leucophaeum, but Fuckel named Fries as the author. Massee, Mon. 243. 1892, cites it as a synonym of Didymium elegantissimum Massee, but on a completely inadequate basis. At least two and probably more species are included. Only examination of type material can determine application.

"Physarum subglobosum Berk. & Curt." ex Berlese, in Sacc., Syll. 7: 352. 1888.

Clearly based on an error, as pointed out by Massee, Mon. 300. 1892. The reference is to P. chrysotrichum Berk. & Curt., Grevillea 2: 66. 1873.

Physarum subtile Pers., Syn. Fung. 171. 1801.

Cited by Rost., Mon. 127. 1874, as a synonym of Tilmadoche nutans.

"Physarum subulatum Sacc., Myc. Ven. spec.," ex Berlese, Sacc., Syll. 357. 1888. Cited as synonym of Craterium leucocephalum. Probably not validly published.

Physarum subulatum Schum., Enum. Pl. Saell. 2: 354. 1803.

Recognized by Fries, Syst. Myc. 3: 133. 1829. Rost., Mon. 129. 1874, cites it as a synonym of *Tilmadoche gracilenta* (Fr.) Rost., "p.p." in index.

Physarum sulcatum Link, Ges. Nat. Freunde Berl. Mag. 3: 27. 1809.

Cited by Rost., Mon. 127. 1874, as synonym of *Tilmadoche nutans*; "p.p." in index. G. Lister, Mycet. ed. 3. 47. 1925, makes it a doubtful synonym of *P. nutans*.

"Physarum sulphureum Sturgis," ex G. Lister, Mon. ed. 2. 60. 1911.

Cited as a synonym of *P. auriscalpium*. Sturgis, Bot. Gaz. 18: 187. 1893, assigned the authorship to Albertini and Schweinitz.

Physarum tucumanense Speg., Rev. Agr. Veter. La Plata 1896: 237.

Cited by G. Lister, Mycet. ed. 3. 261. 1925, as doubtful.

"Physarum verrucosum Link, Herb." ex Rost. Mon. 99. 1874.

Cited as synonym of *Physarum schumacheri* Spreng.; "p.p." in index. Not validly published.

Physarum villosum Schum., Enum. Pl. Saell. 2: 199. 1803.

Uncertain, Rost., Mon. 385, 1875.

"Physarum weinmanii Fries, var. in litt.," ex Berlese, in Sacc. Syll. 7: 344. 1888.

Cited as synonym of *P. cinereum*. Probably an error for *Didymium weinmanni* Fries. In any event, not validly published.

"Physarum xanthopus Wallr., in sched." ex Rost., Mon. 123. 1874.

Not validly published. Mentioned in connection with Craterium xanthopus Wallr., now equated with C. leucocephalum. Not P. xanthopus (Ditmar) Schw.

Tilmadoche anomala Massee, Mon. 333. 1892.

Cited by G. Lister, Mycet. ed. 2. 67. 1911, as a doubtful synonym of *Physarum nutans*.

Tilmadoche cavipes Berk., Grevillea 11: 39. 1882.

Uncertain; Berlese, in Sacc., Syll. 7: 362. 1888.

Tilmadoche minuta (Kickx) Berl., in Sacc., Syll. 7: 361. 1888.

Based on *Craterium minutum* Kickx (publ.?) Not *C. minutum* (in sense of) Fries. The synonymy given is that of *Physarella oblonga* and the description might well apply to that species.

Tilmadoche soluta (Schum.) Fries, Summa Veg. Scand. 454. 1849.

Based on Physarum solutum Schum., q.v.

Trichamphora pezizoides Berk., Intr. Crypt. Bot. 335. 1859, n.v.

Cited by Rost., Mon. App. 16. 1876, "non Jungh," as synonym of Chondrioderma herkelianum Rost., now included in Physarum pezizoideum.

Rostafinski, Versuch 12, 1873 (as tribus).

Capillitium typically limeless, thread-like, purple-brown to pallid. Peridium calcareous, the lime either in the form of amorphous granules and then aggregated into a shell-like outer layer or peg-like protrusions or imbedded in a cartilaginous wall, sometimes scanty, or in the form of crystals and then sprinkled over the surface as scattered crystals or plate-like scales, or imbedded in cartilaginous walls. Spores dark in mass, dark purple-brown or violaceous brown by transmitted light.

Lister (1894) distinguished the Didymiaceae from the Physaraceae by the presence of crystalline as opposed to amorphous lime and this is followed in the later editions of the Lister monograph and by Hagelstein. Macbride (1899) made the distinction between limeless as opposed to limy capillitium, this agreeing with Rostafinski's original treatment. Neither character is entirely consistent but Macbride's treatment is more workable and it does result in placing *Physarina* and *Diderma* where they seem more at home than in the Physaraceae. The curious lime nodules frequently found in the interior of *Lepidoderma granuliferum* are anomalous, but otherwise this is a typical *Lepidoderma*.

KEY	то	GEN	E	RA.
	-			٠.

a.	Peridial lime amorphous, granular.	b
a.	Peridial lime crystalline, the crystals powdering the surface, united into scales or forming a continuous crust.	d
	 Peridial lime scanty, merely powdering surface; capillitium netted, the basal nodes flattened; columella rarely present. 	Wilczekia
	 Peridial lime usually abundant; capillitium usually radiating from a columella or thickened base, rarely replaced by limy columns. 	c
c.	Outer peridium bearing numerous blunt, limy peg-like protuberances.	Physarina
c.	Outer peridium without peg-like protuberances; middle crystalline layer sometimes present. d. Fructification an aethalium.	Diderma Mucilago
	d. Sporangiate or plasmodiocarpous.	e
e.	Crystals scattered on peridium or forming a crust, but not united into scales.	Didymium
e.	Crystals united into distinct scales, scattered or massed on peridium.	Lepidoderma

Wilczekia

Meylan, Bull. Soc. Vaud. Sci. Nat. 56: 68. 1925.

Sporangia small, ovoid, elliptical or subspherical, often somewhat flattened laterally; peridium membranous, opaque, the surface covered by amorphous limy granules and plasmatic deposits; capillitium of colored, branching filaments, similar to that of *Didymium*; columella lacking or scantily developed, to sometimes cylindrical and reaching the summit; spores dark brown.

Type, Wilczekia evelinae Meylan. A single species.

This genus shows relationship with *Diderma* and *Lepidoderma*. From the latter it may be distinguished by the absence of crystalline limy scales on the peridium and possibly by the very limy hypothallus and the columella, when it is present; from the former, only by the membranous peridium with somewhat scantier lime deposits than is usual in *Diderma*. It is difficult to see why it could not be included in *Diderma*. Since we have only a single specimen, from Meylan, even though it is probably part of the type as indicated by place and date of collection, we hesitate to make the transfer.

The original description of the genus describes the peridium as membranous "chargé sur toute sa surface de cristaux amorphes calcaire." That of the species says "cristaux calcaires." There are no crystals in our specimen, and G. Lister (Jour. Bot. 26: 226. 1926), in commenting on the species, makes no mention of crystalline lime. She compares it with *Diachea*, but to us it seems nearest to *Diderma*. Because of the scanty material available, and because Miss Lister seemed to think it a valid genus, we maintain it provisionally.

Wilczekia evelinae Meylan, Bull. Soc. Vaud. Sci. Nat. 56: 69. 1925.

Sporangia sessile on a constricted base, ovoid or elliptical to subcylindrical, or rarely subspherical, often laterally flattened, 0.2–0.4 mm wide, 0.3–0.5 mm tall, dull gray, darker below, somewhat roughened or wrinkled, often in clusters of two or three, such clusters aggregated in larger groups; peridium simple, membranous, its entire surface covered with amorphous lime granules; columella lacking, scantily developed or sometimes cylindrical and reaching the top of the peridial cavity; hypothallus extensive, more or less calcareous; capillitium of dark, rigid filaments united into a firm network, with triangular expansions at the junctions of the threads, especially at the basal portion, retaining its shape after the peridium has broken away; spores black in mass, grayish brown by transmitted light, minutely warted, 9–11 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Ste. Croix, Switzerland.
HABITAT: Dead leaves and twigs of fir.

DISTRIBUTION: Swiss Alps.

ILLUSTRATION: Bull. Soc. Vaud. Sci. Nat. 56: 69, f. 2.

As noted, this appears to be little more than a *Diderma* with single peridium and somewhat scanty lime. The species is certainly distinct.

Physarina

Höhn., Sitz.-ber. Akad. Wien 118: 431. 1909.

Sporangiate, stalked; peridium cartilaginous, appearing single, but composed of two closely compacted layers, enclosing amorphous lime granules and bearing on its surface numerous prominent, blunt, subcylindrical limy pegs, the whole covered with a delicate film, mucous when moist. Capillitium limeless, similar to that of *Diderma*. Spores purplish black in mass.

Type species, Physarina echinocephala Höhn.

As noted by G. Lister in the second and third editions of the Mycetozoa, this genus is very close to *Diderma*, and might well be included in it, perhaps as a

FIG. 302 Plate XXXIII subgenus, but the two known species are so strikingly different in external appearance from any *Diderma* that the maintenance of the genus is as well justified in this case as in several others.

KEY TO SPECIES

a. Pink to flesh-colored or darker;
 spores pale, nearly smooth, without
 encircling ridge, (?7-) 8.5-10.5 μ in diameter.

P. echinocephala

 a. White or ashy; spores dark, angular, prominently and irregularly spiny, with conspicuous encircling ridge, 11-14 μ in diameter.

P. echinospora

Physarina echinocephala Höhn., Sitz.-ber. Akad. Wien 118: 432. 1909.

Sporangia gregarious, stalked, subglobose, somewhat flattened, 0.4–0.6 mm in diameter, total height up to 0.9 mm, pale pink or flesh-colored to darker; peridium double, the inner layer transparent, the outer layer cartilaginous, enclosing amorphous lime granules and bearing numerous cylindrical blunt peg-like protuberances, 80–100 μ high, 40–50 μ wide, filled with amorphous lime granules, with a very delicate third layer best seen surrounding the protuberances; stalk conical or somewhat swollen above the middle, dull, rough, flesh-colored or whitish, filled with lime granules, continuing into the sporangial cavity as a stalked, subglobose or hemispherical columella; capillitium limeless, violet-brown, radiating from the columella and branching and paler toward the tips, with few anastomoses; spores brownish violet in mass, very pale violet or gray by transmitted light, nearly smooth, 8.5–10.5 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Buitenzorg, Java.

навітат: Plant litter.

DISTRIBUTION: Java; Thailand.

ILLUSTRATIONS: Sitz.-ber. Akad. Wien. 118: 158, f. 33; Lister Mycet. ed. 3, pl. 198; Jour. Elisha Mitchell Soc. 84: 51, f. 7–10.

We have examined the collection by Ernst from Java, now at Zürich. This is mentioned by G. Lister, Mycet. ed. 3. 101. 1925. The spores measure 8.5–10.5 μ in diameter, rather than 8–9 μ as stated in the original description, or 7–9 μ as given by G. Lister, but there is some suggestion that the Ernst collection was incompletely matured. There is nothing in the earlier descriptions to suggest a double wall but there is a suggestion of it in the Lister figure cited and also more than a suggestion of the very delicate membrane, which may be a third layer, surrounding the tubercle. A similar membrane occurs in *P. echinospora*.

In his original description von Höhnel gave the color as dark chocolate-brown. It seems possible that this was due to the spore-mass, but see G. Lister's comment.

Physarina echinospora Thind & Manocha, Mycologia 56: 713. 1964.

FIG. 303 Plate XXXIII Sporangiate, stipitate, gregarious, pale gray to ashen, globose to subglobose, erect, 0.5–0.7 mm in diameter, 0.5–1 mm in total height; peridium thin, tough, brittle, calcareous, pale fawn within, bearing numerous blunt, cylindrical limy pegs, somewhat paler than the peridium, 60–120 μ long and up to 55 μ in diameter, the surface rough and often reticulately ridged around the bases of the pegs; dehiscence irregular, stipe short, stout, calcareous, concolorous with the pegs, somewhat ridged, 0.2–0.5 mm long, continuing into

the sporangial cavity as a broadly conical or globose columella; hypothallus small, rotate, calcareous, concolorous with the stipe; columella conspicuous, subglobose to columnar, calcareous, pale fawn, extending to middle of sporangium; capillitium abundant, non-calcareous, violet-brown, radiating from columella and tapering to the paler or hyaline tips, anastomosing, often with membranous expansions at the points of union, readily detached; spores black in mass, very dark under the lens, subglobose, with a prominent ridge surrounding each spore and making it appear walnut-shaped in outline, bearing numerous prominent and unevenly distributed spines, 11.2–14 μ in diameter, including the spines. Plasmodium white.

TYPE LOCALITY: Mussoorie, India.

навітат: Plant litter.

DISTRIBUTION: India; Mexico.

ILLUSTRATION: Mycologia 56: 714, f. 2; Jour. Elisha Mitchell Soc. 84: 50,

f. 1-6, 9, 10.

The preceding description is based on the discussion by Alexopoulos and Blackwell (1968). The species is obviously close to *P. echinocephala*, but differs chiefly in the larger, much darker, strongly spiny, prominently ridged spores. The delicate membrane surrounding the pegs, and which may form a complete outer layer, is readily seen in mounts of the type. Its discovery in Mexico confirms its validity.

Diderma

Pers., Neues Mag. Bot. 1: 89. 1794.
Leangium Link, Ges. Nat. Freunde Berlin Mag. 3: 26. 1809.
Polyschismium Corda, Ic. Fung. 5: 20. 1840.
Chondrioderma Rost., Versuch 3. 1873.

Fructification usually sporangiate, stalked or sessile, less commonly plasmodiocarpous or pseudoaethalioid. Peridium typically double, sometimes apparently single or triple, the outer wall calcareous or cartilaginous, the inner wall membranous, the middle wall, when present, calcareous, amorphous or crystalline. Outer wall in calcareous species composed of amorphous lime granules loosely or densely compacted forming a rough or smooth shell, the inner layer membranous, delicate, free or closely applied to the outer wall; the outer wall, in cartilaginous species, tough, smooth, often shining, closely applied to the inner or middle wall. Columella usually conspicuous, sometimes reduced to a thickened, intrusive, dome-like base. Capillitium thread-like, branching and anastomosing, limeless, or sometimes replaced by limy columns. Spores dark brown or black in mass, deep purplish brown to pale violaceous brown by transmitted light.

Type species, Diderma globosum Pers.

As the name implies, the original emphasis was on the double wall. Persoon listed four species in the original publication. D. contortum is of doubtful identity but probably not a Diderma; D. difforme is now regarded as a Didymium; D. floriforme must be the type of Leangium Link, whether accepted as a genus or subgenus, leaving only D. globosum as the type. Leangium was for a time widely recognized as a genus and was later widely used as a subgenus for the species with cartilaginous walls. As a genus, it is certainly as distinct from Diderma, as restricted to the species with calcareous walls, as are Leocarpus and Craterium from Physarum, hence the designation of Sphaerocarpus floriformis Bull. = D.

floriforme (Bull.) Pers. as the type of Diderma (N. Am. Flora 1 (1): 131. 1949) cannot be accepted.

We retain the division of the genus into the two subgenera Diderma, based on D. globosum Pers., and Leangium (Link) Rost., based on Diderma floriforme (Bull.) Pers.

KEY TO SPECIES

Outer wall of peridium calcareous, fragile, rough or smooth, free or attached to membranous inner wall, but in the latter case breaking away readily; inner wall sometimes apparently lacking; sporangiate, plasmodiocarpous or pseudoaethalioid; dehiscence rarely stellate.

Subgenus Diderma

Outer wall of peridium cartilaginous, tough, shining, usually firmly attached to adjacent wall, if present; dehiscence frequently more or less stellate.

Subgenus Leangium

SUBGENUS DIDERMA

Wall single or appearing so; dehiscence irregular.

b

Wall clearly double; dehiscence irregular, operculate or stellate.

e

Orange-brown to brick red, varying to ochraceous or yellow; sporangiate, sessile, often heaped.

D. simplex

Flesh colored to white, without orange or reddish tints.

c

Peridium thick, rough, white or tinged with lilaceous c. above; pulvinate on a broad base to plasmodiocarpous.

D. indicum

Peridium thin, smooth or nearly so, fragile, shining; sporangiate. c. Grayish white to pearl

d

gray, subglobose on a restricted base.

D. cinereum

Flesh colored to white; short-stalked to sessile on a constricted base; peridium usually double.

D. montanum

Sporangiate, sessile, rarely with a constricted stem-like base, varying to subplasmodiocarpous or broadly expanded.

f

Sporangiate, stalked, or, if sessile, e.

usually associated with stalked sporangia.

t

Sporangia subglobose to pulvinate, usually closely aggregated or densely massed on and sometimes more or less immersed in a conspicuous white or pale ochraceous hypothallus, which is sometimes reduced or almost lacking.

Sporangia not massed on a conspicuous pale hypothallus; sporangiate to plasmodiocarpous, often depressed and expanded.

m

g

Sporangia densely clustered, often massed and superimposed,

tending to be more or less immersed in hypothallus.

spores pale, minutely warted, mostly 8-11 μ .

h i

Sporangia aggregated or gregarious, never immersed in hypothallus. g.

Hypothallus profuse; sporangia deeply imbedded, the outer peridium chalky, rough, usually closely attached to the dull inner peridium; columella subglobose to pulvinate, usually ochraceous;

D. spumarioides

	h.	Hypothallus profuse to scanty; sporangia not deeply imbedded, sometimes superficial, the outer peridium smooth, crustose, the inner peridium free, often distant; spores dark, strongly marked.	i
i.	som	res dark, strongly warted or spinose, etimes subreticulate, mostly $12-15~\mu$; inner peridium escent blue, distant; sporangia often superimposed.	D. crustaceum
i.	spar	res moderately dark, distinctly but sely warted, mostly 9–10 μ; inner peridium ν_t , slightly iridescent; sporangia ally in a single plane, sometimes only aggregated.	D. globosum
	j.	Sporangia large, 1–1.5 mm in diameter, subglobose, not depressed; spores dark, prominently spiny to subreticulate, 14–17 μ . Sessile forms of	D. lyallii
	j.	Sporangia smaller, rarely exceeding 1 mm, often depressed; spores smaller.	k
k.		res more or less culate, 10–12 μ , columella white. D .	subdictyospermum
k.	Spo l.	res not reticulate; columella ochraceous to brown. Sporangia pulvinate to subplasmodiocarpous; dehiscence irregular; columella depressed-pulvinate, ochraceous to brown; spores spinulose, 11–12µ.	l D. alpinum
	l.	Sporangia patelliform; dehiscence by a preformed lid; columella globose to hemispherical, brown; spores punctate, 7–10 μ .	D. mussooriense
m.		ctifications depressed, sporangiate and vinate varying to plasmodiocarpous or pseudoaethalio	id. n
m.	Fru	ctifications not as a rule notably depressed.	q
	n.	Outer peridium smooth, polished, porcelain-like; sporangia flat-pulvinate, lilaceous to pinkish, fading to white.	D. testaceum
о.	dep plas	Outer peridium not porcelain-like. brangiate, sessile, pulvinate to bressed-pulvinate, varying to smodiocarpous, but not reticulate nor adly effused; capillitium coarse; spores 12–13 µ.	o D. chondrioderma
o.	Spo	orangiate, then strongly flattened, ying to plasmodiocarpous, often closely oressed and widely effused; capillitium delicate.	p. enonarioaerma
	p.	Sporangia usually distinct, but often closely appressed and forming a reticulate pattern, varying to broadly effused; spores 7–9 μ .	D. effusum
	p.	Always plasmodiocarpous, very thin; spores 10–11 μ (6–7 μ in var. berkeleyanum).	D. platycarpum
q.	sho app	orangiate, subglobose, sessile or ort-stalked; outer peridium smooth, oearing cartilaginous but composed of sely aggregated lime granules;	
_	col	umella clavate, pale purplish to purplish red.	D. cor-rubrum
q.	spo r.	orangiate to plasmodiocarpous; columella not purplish Pulvinate to annulate or plasmodiocarpous; columella reduced to a thickened orange base; sporangia white to pale cream-colored or lilaceous.	n. r D. deplanatum

	r. Subglobose on a restricted base to hemispherical; columella well-developed.	s
		D. niveum
s.	Sporangia white to pale pinkish buff; spores under 12 μ .	D. moeum
s.	Sporangia flesh-colored to	D. subincarnatum
	dark pinkish brown; spores 13–15 μ.	D. submeamatam
	t. Sporangia white, flattened, discoid, umbilicate below; stalk stout,	
		D. hemisphaericum
		•
		u
u.	White or pinkish, always stalked;	D. montanum
	hypothallus not prominent; spores 8–10 μ .	D. momanum
u.	Dull white or flesh-colored;	
	stalks sometimes short, frequently lacking;	D. lyallii
	hypothallus usually prominent; spores 14–17 μ .	D. tyutti
SUB	GENUS LEANGIUM	
	nk) Fries, Syst. Myc. 3: 98. 1829 (as tribus)	
a.	Peridium of three layers, a middle calcareous layer firmly	
	united with outer cartilaginous wall; inner wall usually fr	ee. b
a.	Peridium without a middle calcareous layer.	С
	b. Middle calcareous layer of closely	
	compacted crystalline lime nodules.	D. trevelyani
	b. Middle calcareous layer not crystalline.	D. asteroides
		_
c.	Peridium single or appearing so.	d
c.	Peridium clearly double.	f
	d. Stalked, globose, white or pallid above, rarely sessile; peridium reticulately rugose, breaking up into preformed platelets; columella prominent.	D. rugosum
	d. Sessile or with very short stalks;	C
	distinctly colored; peridium not breaking up into preformed platelets; columella pulvinate or lack	king. e
•	Dull gray; subglobose or depressed, sessile on a	cmg.
e.	restricted base or with very short stalk and then umbilication	nte. D. imperialis
	·	•
e.	Bright yellow-brown; pulvinate on a broad base.	D. darjeelingense
	f. Sessile or with a short, thick stem.	g
	f. Usually stalked, rarely sessile.	i
g.	Dark reddish brown; spores	
	dark, encircled by a pale band.	D. antarcticum
g.	Olivaceous, ochraceous or white;	
	spores not encircled by a pale band.	h
	 h. Dark ochraceous to olivaceous, wrinkled; capillitium purplish; spores pale, 9–11μ. 	D. ochraceum
	h. Pale ochraceous to white; capillitium	2. 00
	pale or colorless; spores dark, 12-13 μ.	D. sauteri
i.	Sporangia discoid, red-brown with pale lines	_
	marking areas of dehiscence into plate-like fragments.	D. roanense
i.	Sporangia globose or pyriform; dehiscence stellate.	j
	j. Orange or vermilion; spores spinulose, 13–15 μ .	D. lucidum
	j. Gray to reddish brown; spores not exceeding 12 μ .	k
k.	Sporangia mottled; dehiscence stellate to base.	D. radiatum
k.	Sporangia not mottled; upper part of	_ ,
٨.	peridium dehiscent in stellate lobes, the	
	lower part tending to persist as a cup.	D. floriforme
	_ ~ .	

Diderma alpinum Meylan, Bull. Soc. Vaud. Sci. Nat. 51: 261. 1917.

Diderma globosum var. alpinum Meylan, Ann. Cons. Jard. Genève 15–16: 310. 1913.

FIG. 304 Plate XXXIV

Sporangia sessile, pulvinate, white, crowded, 0.7-1(-2) mm in diameter, often elongated into short plasmodiocarps, seated on a conspicuous white hypothallus but not deeply immersed; peridium double, the walls distant or readily separating; outer peridium white, calcareous, crustose, smooth, inner peridium membranous, shining, translucent, pale flesh colored; columella pulvinate, it and the inner walls of the base ochraceous-orange; hypothallus white, calcareous, prominent, but mostly under sporangia, sometimes containing large, subcrystalline nodules; capillitium of purplish or hyaline, branched and anastomosing threads, bearing dark fusiform swellings, copious or sparse; spores black in mass, purplish brown by transmitted light, distinctly and somewhat irregularly spinulose, $11-12~\mu$ in diameter. Plasmodium white.

TYPE LOCALITY: Switzerland.

HABITAT: Dead herbaceous stems or living herbs, usually near melting snow.

DISTRIBUTION: Swiss Alps; ?Mountains of northern India.

EXSICCATI: Jaap, Myxom. Exs. 127, 188.

Differing from *D. globosum*, of which it was originally described as a variety, in the larger, flatter, more plasmodiocarpous aspect, and especially in the broad, flat, bright colored columella and adjacent inner base. As noted in the Lister monograph there are large, subcrystalline nodules imbedded in the base and hypothallus.

The var. macrosporum Meylan, Bull. Soc. Vaud. Sci. Nat. 58: 319. 1935, is described as having adherent peridial walls and spores 15–18 μ in diameter. It may be worthy of specific rank.

A collection from the foothills of the Himalayas, K. S. Thind 83, should perhaps be referred to this species. The sporangia are smaller, 0.5–0.6 mm in diameter, but have the same flattened orange columella and base; the spores are also smaller, $(9-)9.5-10.5~\mu$, with sparsely scattered spines. It was referred to D. spumarioides on the basis of the spore size, but seems closer to D. alpinum, of which it might be considered a variety or even a closely related, but distinct, species.

Diderma antarcticum (Speg.) Sturgis, Mycologia 8: 37. 1916.

Licea antarctica Speg., Bol. Acad. Nac. Cienc. Cordoba 11: 56. 1887.

Sporangiate, sessile; sporangia closely aggregated in groups of 10–50 or more, dark reddish brown, subglobose or angular from pressure; peridium double, the outer wall thick, brittle above, persistent and cartilaginous below, closely united with the delicate membranous inner layer upon which minute white lime granules are densely scattered; capillitium rather scanty, the threads coarse or slender, dark in the center, pale at the extremities, occasionally with pale brown membranous expansions from which the threads radiate; columella rough, indeterminate, calcareous, pale yellow; spores black in mass, dark purplish brown by transmitted light and encircled by a pale band, minutely spinulose, often bearing one or more raised bands, 10.5–11.5 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Punta Arenas, Chile. HABITAT: Rotted trunks of *Nothofagus*.

DISTRIBUTION: Known only from Patagonia. ILLUSTRATION: Lister, Mycet. ed. 3, pl. 209.

Two specimens from southern California collected by Plunkett in 1927 and 1932, were determined by Miss Lister as this species, but they differ from the published descriptions of D. antarcticum in several respects, including the pinkish buff rather than dark brown peridium, the character of the outer wall, the much larger spores without the pale line and the character of the capillitium and columella. These differences are noted by Plunkett (1934, p. 41) who suggested that his collections might represent a distinct species, and this is repeated by Martin (1949, p. 139). Dr. Kowalski has found similar fruitings in northern California and has recently described them as D. subincarnatum, q. v. Our slides of Spegazzini's type show only mostly collapsed spores and bits of the peridium. The best spores are not more than $12~\mu$ in diameter and show faint suggestions of the pale band. Hagelstein regarded the species as described by Sturgis on the basis of Thaxter's Patagonian collection as referable to D. asteroides, but that is not acceptable.

In all probability, the Lister illustration was based on Thaxter's collection, studied by Sturgis.

Diderma asteroides (A. & G. Lister) G. Lister, in Lister, Mycet. ed. 2. 113. 1911.

FIG. 305 Plate XXXIV Chondrioderma asteroides A. & G. Lister, Jour. Bot. 40: 209. 1902.

Sporangia hemispheric, globose, or ovoid, the apex often more or less acuminate, sessile, 0.2–0.8 mm in diameter, rarely short-stalked or plasmodiocarpous, brown or chocolate, more or less marked by radiant lines converging at the top; wall triple, the brown, cartilaginous outer layer firmly attached to the middle white layer of closely aggregated lime granules, the membranous inner layer usually free, sometimes distant; columella globose or depressed-globose or sometimes poorly developed, rugose, pallid to deep ochraceous, capillitium of slender, anastomosing, purplish threads paler at tips; spores black in mass, smoky violaceous brown by transmitted light, verrucose, 10– $12~\mu$ in diameter. Plasmodium yellow or orange.

TYPE LOCALITY: Italy.

HABITAT: Dead wood, bark, and leaves, especially of pine, and mosses.

DISTRIBUTION: Great Britain, Germany, Switzerland, Italy, Portugal, Rumania; in North America, known from Ontario, Colorado, Washington, Oregon, California.

ILLUSTRATIONS: Jour. Bot. 40; pl. 438, f. 1; Lister, Mycet. ed. 3. pl. 97. EXSICCATI: Jaap, Myxom. Exs. 171; Brândză, Myxom. Roum. III. 1: 13(NY); 100(IA).

The triple wall, with the two outer layers finally broadly expanded, exposing the white calcareous middle layer as a white star against the background, distinguish this species.

Diderma chondrioderma (de Bary & Rost.) G. Lister, in Lister, Mycet. ed. 3. 258. 1925.

FIG. 306 Plate XXXIV Didymium chondrioderma de Bary & Rost., in Aleksandrovich, Stroj. Miksom. 89. 1872.

Chondrioderma alexandrowiczii Rost., Mon. 169. 1874.

Didymium alexandrowiczii (Rost.) Massee, Mon. 232. 1892.

Diderma arboreum G. Lister & Petch., in G. Lister, Jour. Bot. 51: 2. 1913.

Sporangia scattered, discoid, sessile or rarely stalked, 0.5–0.7 mm in diameter, or forming expanded and lobed, flattened plasmodiocarps 1–3 mm in diameter, white or purplish gray from lack of lime; peridium single, membranous, with deposits of round or angular lime granules united to form a thin, rather rough and irregular crust or sparsely distributed, sometimes limeless or nearly so, often with scattered deposits of amorphous material; columella flesh-colored, sometimes nearly obsolete; stalk, when present, very short, dark brown; capillitium coarse, purplish or colorless, often with membranous expansions at the joints; spores pale purplish gray by transmitted light, minutely and closely spinulose (10–)12–13(–15) μ in diameter. Plasmodium white, then violet.

TYPE LOCALITY: Poland.

HABITAT: Mosses and lichens on the bark of trees.

DISTRIBUTION: Great Britain; Poland; Rumania; Ceylon; Malaya; Japan; in the United States, reported from Florida, Iowa, Colorado, Texas and California.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 206; Hattori, Myxom. Nasu pl. 10, f. 6.

This is a puzzling species, apparently rare in North America, and our specimens are not very satisfactory. The peridium appears to be single, but when the limy incrustation is thick, it takes on the nature of an outer wall; we also have collections in which the lime is scanty or lacking. Hagelstein (1944) notes its relationship with *D. effusum*, from which it differs notably in habit, in less flattened fruitings, and in the larger and paler spores.

Diderma cinereum Morgan, Jour. Cinc. Soc. Nat. Hist. 16: 154. 1894.

Sporangiate, subglobose, depressed, sessile on a somewhat restricted base, pearl gray, 0.3–0.5 mm in diameter, gregarious to crowded and sometimes somewhat irregular in outline; peridium appearing single, dehiscent irregularly from above, the wall thin, smooth, crustose, limy; hypothallus colorless, inconspicuous, with occasional patches of lime granules; columella white, hemispheric to subglobose, conspicuous; capillitium of slender, dark threads, paler at the extremities, rather sparsely branched and anastomosing, readily detached from columella; spores globose, dark violaceous gray, minutely warted, 9–11 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Preston, Ohio. HABITAT: Dead wood and leaves.

DISTRIBUTION: New York, ?Pennsylvania, Virginia, Ohio, Iowa.

ILLUSTRATION: Jour. Cinc. Soc. Nat. Hist. 16; pl. 12, f. 46.

In the second and third editions of the Lister Monograph this species is listed, without comment, as a synonym of *D. spumarioides*. Hagelstein (Mycet. N. Am. 97. 1944) suggests that it is an early spring phase of that species. Macbride recognized it as a distinct species in both editions of his N. Am. Slime-Moulds, but Macbride and Martin followed Lister in uniting it with *D. spumarioides*, as did Martin in N. A. Flora, 1949.

Reexamination of Morgan's type specimen and of a specimen collected in New York by Rex and sent by him to Wingate in Philadelphia and from Wingate to Macbride (which may be the source of Macbride's Pennsylvania listing) makes it seem clear that *D. cinereum* is an autonomous species and should be recognized as such. It differs from *D. spumarioides*, not only in the lack of the prominent

FIG. 307
Plate XXXIV

hypothallus, but in the smooth, apparently single, pearl-gray peridium, in the very regular sporangia, in the loose attachment of the capillitial threads, which fall away early exposing the prominent columella, and in the dark grayish, minutely warted spores. We also have a small specimen from Iowa collected by Macbride. It is probable that examination of a series of specimens assigned to D. spumarioides or D. globosum might disclose others referable to this species.

As in other Didermas in which the wall is said to be single, it is doubtful whether this is really the case. There is some suggestion that there may be a very delicate inner membrane so closely applied to the outer wall as to make the wall appear single, not only under a binocular but under the microscope.

Diderma cor-rubrum Macbr., N. Am. Slime-Moulds ed. 2. 140. 1922.

FIG. 308 Plate XXXIV Sporangia clustered or gregarious, globose or somewhat depressed, 0.5–0.7 mm in diameter, short-stalked or sessile, white or pale pinkish gray; peridium double, the outer layer calcareous, polished, rugose, reddish purple within, the inner layer delicate, shining, membranous, translucent, closely applied to the outer layer but somewhat separable; columella clavate, spherical above, grayish purple to deep purplish red, sometimes connected by stout, calcareous bars with the peridium; stalk, when present, short, stout, furrowed, white or pinkish, merging with the white hypothallus; capillitium of slender purplish or hyaline threads, or purplish with hyaline tips, sparsely branched; spores globose to ovate, sometimes apiculate at one or both ends, black in mass, smoky-brown by transmitted light, verrucose, $(10.5-)11-12~\mu$ in diameter. Plasmodium unknown.

TYPE LOCALITY: Iowa.

HABITAT: Dead wood and leaves.

DISTRIBUTION: New York, Iowa, Kansas, Colorado; West Africa. ILLUSTRATIONS: Macbr. N. Am. Slime-Moulds ed. 2. pl. 18, f. 2.

G. Lister (Mon. ed. 3. 84. 1925) and Hagelstein treat this as a synonym of D. montanum but the finding of representative specimens in other localities, particularly West Africa, seems amply to justify its recognition. The type was sent to Miss Lister by Dr. Macbride many years ago and is now in the British Museum. In the original description, Macbride described the outer peridium as cartilaginous, but in the material we have it is composed of closely aggregated lime granules. It is very delicate and might easily be interpreted as cartilaginous under a binocular. In Jour. Bot. 75: 327. 1937, Miss Lister acknowledged the validity of Macbride's species.

In the mount of the Kansas specimen illustrated there are conspicuous, large, subcrystalline lime nodules, apparently imbedded in the columella. Similar nodules occur in the columella and hypothallus of other species.

Diderma crustaceum Peck, Ann. Rep. N. Y. State Mus. 26: 74. 1874.

FIG. 309
Plate XXXIV
Chondrioderma crustaceum (Peck) A. Berl., in Sacc. Syll. Fung. 7: 373. 1888.

Sporangia crowded, sometimes superimposed, often forming a pulvinate colony, white or pale ochraceous, globose or depressed, often distorted by pressure, 0.3–0.8 mm in diameter, on a conspicuous white or creamy hypothallus in which the sporangia are rarely deeply imbedded; peridium double, the outer peridium smooth, chalky, firm, fragile, separated and usually remote from the membranous, blue, iridescent inner peridium; columella small, white, globose or clavate, often lacking; capillitium dark, fading toward tips, rather sparsely branched and with few anastomoses, often with dark accretions on the threads; spores dark, spiny, sometimes appearing subreticulate, $(11–)12–14(-15)~\mu$ in diameter. Plasmodium at first watery, then milky white.

TYPE LOCALITY: Memphis, New York.

HABITAT: Dead leaves and twigs, not rarely encrusting living plants.

DISTRIBUTION: Very common in eastern North America east of the Rocky Mts.; uncertain elsewhere.

ILLUSTRATIONS: Macbr., N. Am. Slime-Moulds, pl. 7, f. 7 (both editions); Jour. Cinc. Soc. Nat. Hist. 16; pl. 12, f. 45; Lister, Mon. ed. 3, pl. 45 (as D. globosum).

Peck's original description is brief and rather sketchy. He says, "columella none," which is true of some collections, but does emphasize the large, dark spores. Morgan (Jour. Cinc. Soc. Nat. Hist. 16: 153. 1894) gives an excellent description. A. Lister (Mon. Mycet. 78. 1894) cited the species as a synonym of D. globosum. Macbride (N. Am. Slime-Moulds, 98. 1899) registered his dissent from this, but G. Lister, in the Mon., ed. 2, p. 104, 1911, and ed. 3, p. 88, 1925, repeated A. Lister's synonymy. Macbride (N. Am. Slime-Moulds, ed. 2. 134. 1922) discussed at length why he could not accept this. Nevertheless, Macbride and Martin (1934), Hagelstein (1944) and Martin (1949) accepted the Lister's disposition of Peck's species.

There can be no question that D. globosum, D. crustaceum and D. spumarioides are much alike in general habit, but examination of a wide range of material shows that the collections fall into three groups: (1) those with a rather scanty hypothallus, a smooth, calcareous outer peridium which is free and often distant from the gray, membranous, somewhat iridescent inner peridium, a prominent subglobose columella and small, dark, strongly but sparsely warted spores mostly $10-12~\mu$ in diameter (D. globosum); (2) those with a very conspicuous limy hypothallus in which the sporangia may be deeply imbedded, with a rough, chalky outer peridium, closely appressed to the membranous, dull gray inner peridium, a flat, pulvinate, often colored columella and minutely warted, pale spores mostly $8-11~\mu$ in diameter (D. spumarioides); (3) those with a very conspicuous limy hypothallus, with the sporangia superficial or only slightly imbedded in it, with smooth, chalky outer walls remote from the iridescent blue inner peridium, a small, globose or clavate columella which is often lacking, and large, dark, spiny, sometimes subreticulate spores mostly $12-14~\mu$ in diameter (D. crustaceum).

Prematurely dried specimens of *D. spumarioides* may appear to have widely separated peridia; see comments under that species.

Because of the confusion between these species, the synonymy given for the first two species can be regarded as no more than probably correct.

Diderma darjeelingense Thind & Sehgal, Mycologia 56: 562. 1964.

Sporangiate or somewhat plasmodiocarpous, bright brown, gregarious, small, sessile, pulvinate, globose, subglobose or elongate; peridium single, thick, calcareous, minutely papillate; hypothallus inconspicuous, membranous, concolorous with peridium; dehiscence irregular, the peridium remote from the spore mass; columella prominent, hemispherical to columnar, elongated in plasmodiocarps, calcareous, white to cream-colored; capillitium abundant, violaceous brown, paler to hyaline at tips, forking and anastomosing, with occasional expansions at the angles; spores brownish black in mass, yellow-brown by transmitted light, minutely and profusely verrucose, the warts tending to be aggregated in indistinct clusters, ovoid or elliptical, $12-13.3 \times 9-10\mu$, or globose, $9.8-12\mu$ in diameter. Plasmodium unknown.

TYPE LOCALITY: Darjeeling, India. HABITAT: On herbaceous leaves.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATIONS: Mycologia 56: 563, fig. 2.

FIG. 310 Plate XXXIV A very distinctive species. The spore mass is solid, and distinct from the outer wall. It is possible that it is surrounded by a very delicate membrane in early stages, but, if so, that is not apparent in the material we have of the type. It is equally possible that the spores are merely agglutinated in the type specimen, and this might be correlated with their somewhat variable shape.

Diderma deplanatum Fries, Syst. Myc. 3: 110. 1829.

FIG. 311 Plate XXXIV Leocarpus deplanatus (Fries) Fries, Summa Veg. Scand. 450. 1849.

Chondrioderma deplanatum (Fries) Rost., Mon. App. 17. 1876.

Diderma niveum subsp. deplanatum G. Lister, in Lister, Mycet. ed. 2. 106. 1911.

Sporangia scattered or in small groups, pulvinate, sessile, 1–1.5 mm in diameter, or forming curved or ring-shaped plasmodiocarps, white or pale cream-colored or lilaceous; peridium double, the outer layer smooth, crustose, brittle, thick, the inner layer membranous, iridescent, deep orange below; columella lacking or represented by a broadly convex or thickened orange-brown base; capillitium composed of dark purple, simple or sparsely branched threads, often bearing spiny or nodular enlargements; spores rather dark yellow-brown by transmitted light, minutely spinulose, (9-)9.5-10(-11) μ in diameter. Plasmodium white.

TYPE LOCALITY: Germany.

HABITAT: Dead leaves, twigs and mosses.

DISTRIBUTION: Western Europe; India; in North America known only from

the states of Washington and California. ILLUSTRATION: Lister, Mycet. ed. 3. pl. 89, d. EXSICATTI: Jaap, Myxom. Exs. 9, 45, 89, 189.

Diderma contortum Hoffm., Fl. Crypt. Germ. 3: pl. 9, f. 2a. 1795, may represent an earlier name for this species. Fuckel, Jahrb. Nass. Ver. Nat. 23-24: 341. 1870, applied Hoffmann's name to *Physarum bivalve*. That is the source of "D. contortum Fckl." in the literature, which was, of course, not validly published. Hoffmann may have been applying Persoon's name of 1794; the original has not been seen.

The species is very rare in North America; apparently less so in Europe. One of the Indian collections referred here (K. S. Thind 135) is composed almost entirely of very greatly flattened ring-shaped plasmodiocarps and has spores only 8.5–9 μ in diameter. It may be undescribed. Other Indian collections from the same area are also not quite the same as those from Europe and the western United States, but there is no other species to which they can be assigned.

FIG. 312 Plate XXXIV Diderma effusum (Schw.) Morgan, Jour. Cinc. Soc. Nat. Hist. 16: 155. 1894. Physarum effusum Schw., Trans. Am. Phil. Soc. II. 4: 257. 1832.

Didymium reticulatum Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27-28: 73. 1873. Not D. reticulatum Berk. & Br. 1876.

Chondrioderma reticulatum (Rost.) Rost., Mon. 170. 1874.

Chondrioderma saundersii Berk. & Br., ex Massee, Mon. 209. 1892.

Diderma reticulatum (Rost.) Morgan, Jour. Cinc. Soc. Nat. Hist. 16: 155. 1894.

Physarum crustiforme Speg., Anal. Mus. Nac. Buenos Aires 6: 200. 1898.

Fructification varying from sporangiate, pulvinate, and sessile or rarely with a short, thick, stem-like base, 0.5–1.5 mm broad, often forming a reticulate pattern, through tessellate colonies to broadly effused, continuous, crustose pseudoaethalia up to 6 cm long; peridium double, the outer wall calcareous, crustose, smooth or occasionally bearing scattered crystalline disks, sometimes free and detached as a lid, exposing the intact membranous inner wall, sometimes closely united with the inner wall; columella flat-pulvinate, pinkish brown, sometimes scarcely more than a thickened base; capillitium delicate, the threads colorless or pale purple, sparingly branched and anastomosing; spores dark purple in mass, pale violaceous brown by transmitted light, minutely warted, with faint clusters of larger warts, 7–9(–10) μ in diameter. Plasmodium white

TYPE LOCALITY: Salem, North Carolina.

HABITAT: Dead leaves and stems of herbaceous plants; sometimes wood or dung.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 83, f; Macbr. & Martin, Myxom. pl. 8, f. 178–181; Hattori, Myxom. Nasu pl. 10, f. 4.

EXSICCATI: Ellis, N. Am. Fungi 1217 (as Chondrioderma michelii); Brândză, Myxom. Roum. 34(NY); 49(IA); Thaxter, Rel. Farl. 392a, b.

This very common and widely distributed species is also very variable, but is not difficult to recognize under its variations. The flat, usually densely clustered sporangia, often mingled with elongate forms which have to be called plasmodiocarps, and the small pale spores are constant. Even in the closely packed pseudoaethalioid masses the identity of the constituent sporangia is preserved and their upper peridia have the same tendency to break away as a whole as do the less closely compacted fruitings, but in neither case is there evidence of a preformed fissure.

Diderma floriforme (Bull.) Pers., Neues Mag. Bot. 1: 89. 1794.

Sphaerocarpus floriformis Bull., Hist. Champ. Fr. 142. 1791.

Stemonitis floriformis (Bull.) J. F. Gmel., Syst. Nat. 2: 1469. 1791.

Lycoperdon floriforme (Bull.) With., Brit. Pl. ed. 3. 4: 376. 1796.

Didymium floriforme (Bull.) Schrad., Nov. Gen. Pl. 21. 1797.

Diderma spurium Schum., Enum. Pl. Saell. 2: 197. 1803.

Reticularia floriformis (Bull.) Poir., in Lam. Encyc. 6: 182. 1804.

Leangium lepidotum Ditmar, in Sturm, Deuts. Fl. Pilze 3: 43. 1814.

Leangium floriforme (Bull.) Link, ex S. F. Gray, Nat. Arr. Brit. Pl. 1: 573. 1821.

Cionium floriforme (Bull.) Spreng., Syst. 4(1): 529. 1827.

Cionium lepidotum (Ditmar) Spreng., Syst. 4(1): 529. 1827.

Diderma lepidotum (Ditmar) Fries, Syst. Myc. 3: 100. 1829.

Chondrioderma floriforme (Bull.) Rost., Mon. 184. 1874.

Sporangia stipitate, crowded in dense and often large colonies, globose or pyriform, 0.7–1 mm in diameter, 1.2–2 mm tall, pale brown to umber or deep reddish brown; peridium double, the outer layer cartilaginous, usually adherent to the membranous inner layer, the dehiscence irregular above, the lower portion dividing into petal-like lobes which often become deeply reflexed and rolled, the base tending to persist as a cup; columella prominent, clavate, globose above, the surface rugose, densely calcareous, ochraceous to brown; stalk weak, fur-

FIG. 313
Plate XXXV

rowed, orange-brown or concolorous to dark, usually merging into the prominent hypothallus; capillitium abundant; the threads delicate, slender, sinuous, dark brown, often bearing bead-like thickenings; spores intense black in mass, dark purplish brown and paler on one side by transmitted light, sparsely and irregularly marked with large, blunt warts, 10–11 μ in diameter. Plasmodium yellow or grayish white.

TYPE LOCALITY: France. HABITAT: Decaying wood.

DISTRIBUTION: Widely distributed in north temperate regions.

ILLUSTRATIONS: Bull., Herb. Fr. pl. 371; Lister, Mycet. ed. 3. pl. 92; Macbr. & Martin, Myxom. pl. 9, f. 208, 209.

EXSICCATI: Ellis, N. Am. Fungi 1121; Brândză, Myxom. Roum. I. 1: 12, 36, 104(NY); 52(IA); Thaxter, Rel. Farl. 803.

The well-developed, sparsely scattered warts on the spores, as well as the external habit, are distinctive. The Lister monograph emphasizes the purplish red color of the spores, but this seems to be not as striking as is there suggested.

As Hagelstein notes, the lime may be in the form of vitreous disks or plates. We have specimens showing this; the suggestion is that the lime has been wet and dried with partial crystallization.

Diderma globosum Pers., Neues Mag. Bot. 1: 89. 1794.

Didymium candidum Schrad., Nov. Gen. Pl. 25. 1797.

Reticularia globosa (Pers.) Poir., in Lam. Encyc. 6: 182. 1804.

Didymium globosum (Pers.) Chev., Fl. Paris 1: 334. 1826.

Cionium globosum (Pers.) Spreng., Syst. 4(1): 529. 1827.

Chondrioderma globosum (Pers.) Rost., Mon. 180. 1874.

Chondrioderma affine Rost., Mon. App. 18. 1876.

Chondrioderma similans Rost., Mon. App. 20. 1876.

Sporangia sessile, globose, 0.5–1 mm in diameter, gregarious, or densely crowded and angular from pressure, often massed into a pseudoaethalium, rarely plasmodiocarpous, white or ochraceous, rarely faintly lilaceous, borne on a scanty hypothallus; peridium double, the outer wall calcareous, smooth, polished, fragile, usually remote from the membranous, dark, smooth or corrugated, slightly iridescent inner wall; columella usually large, white, hemispheric or globose, often pedicellate; capillitium abundant, pale brown or purplish, rather delicate, the threads branching and sparsely anastomosing, often bearing irregular expansions toward the base; hypothallus white or cream-colored, usually profuse and spreading beyond the sporangia; spores black in mass, yellowbrown by transmitted light, distinctly but sparsely warted (8–)9–10(–11) μ in diameter, Plasmodium white.

TYPE LOCALITY: Europe.

HABITAT: Dead wood or litter; often encrusting living plants.

DISTRIBUTION: Widely distributed in Europe, Canada and the United States. ILLUSTRATIONS: Neues Mag. Bot. 1: pl. 1, f. 4, 5; Macbride, N. Am. Slime-Moulds ed. 2, pl. 7, f. 4, 4a.

EXSICCATUS: Jaap, Myxom. Exs. 126.

This is essentially D. globosum as defined by Macbride, N. A. Slime-Moulds, ed. 2. 134. 1922. As Macbride points out, the common species in the D. globosum-

FIG. 314 Plate XXXV D. spumarioides complex in eastern North America is what Peck described as D. crustaceum, and the recent texts, following G. Lister in regarding D. crustaceum as a synonym of D. globosum, have greatly confused the situation. The double walls are not always remote, but the spore size and spore markings seem to be constant, and perhaps the most reliable character on which to base distinction of the three species.

Whether this is actually D. globosum of Persoon can be determined only by examination of type material if it is still in existence. His description is extremely brief and gives, of course, no spore dimensions, and his illustration does not show the hypothallus, nor do those of Bulliard (Herb. Fr., pl. 445, f. 2. 1789), nor Greville (Scot. Crypt. Fl., pl. 122. 1824). Rostafinski (Mon. 180. 1875) is the first to indicate the spore size, which he gives as 8.3 µ, possibly representing, as Macbride suggested, an average of a number of measurements. A. Lister (Mon. 78 1894) reported that Rostafinski's "type specimen" has dark, spinulose spores 11-13 μ in diameter. A. Lister's use of "type" was not what is now regarded as justified, and the references in the later editions make it clear that this was no more than one of the specimens named by Rostafinski. The situation is complex, but Rostafinski did indicate the small-spored form as D. globosum Pers. in his opinion, and it seems hopeless to try to distinguish between the descriptions of the various forms to which these names have been applied as given by the earlier authors. The specimen selected for illustration was determined as D. globosum by Macbride. It agrees with Persoon's original illustration except for the thin, but evident, hypothallus. It is also uncomfortably close to D. testaceum but does not have the spores of that species.

Lister's pl. 85 of Mycet. ed. 3. represents what is here called D. crustaceum.

Diderma hemisphaericum (Bull.) Hornem., Fl. Dan. 33: 13. 1829.

Reticularia hemisphaerica Bull., Hist. Champ. Fr. 93. 1791.

Physarum depressum Schum., Enum. Pl. Saell. 2: 202. 1803.

Reticularia contorta Poir., in Lam., Encyc. 6: 182. 1804.

Didymium hemisphaericum (Bull.) Fries, Syst. Myc. 3: 115. 1829.

Didymium michelii Libert, Pl. Crypt. 180. 1832.

Physarum michelii (Libert) Corda, Ic. Fung. 5: 57. 1842.

Chondrioderma michelii (Libert) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27–28: 74. 1873.

Diderma michelii (Libert) Morgan, Jour. Cinc. Soc. Nat. Hist. 16: 153. 1894. Chondrioderma hemisphaericum (Bull.) Torrend, Broteria 7: 103. 1908.

Sporangia gregarious, discoid, 0.6-1.2 mm in diameter, often depressed above and umbilicate below, stipitate or sometimes sessile; peridium double, the outer layer white, fragile, crustaceous, soon breaking at the margins, and often dehiscent as a lid, closely applied to the delicate, cinereous inner layer, which ruptures irregularly; columella broad, pinkish; stalk up to 1 mm tall, usually shorter, rather stout, calcareous, white or pallid to alutaceous or brownish, longitudinally furrowed, the ridges continued as veins on the lower surface of the sporangium, rarely lacking; capillitium delicate, the threads colorless or pale violet-brown, sparsely branched, often scanty; spores pale yellowish brown by transmitted light, very minutely warted, the warts often clustered, (7-)8-9(-10) μ in diameter. Plasmodium opaque white.

TYPE LOCALITY: France.

HABITAT: On leaves and other plant litter, occasionally on wood.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Bull., Herb. Fr. pl. 446, f. 1; Sow., Engl. Fungi pl. 12;

FIG. 315 Plate XXXV Rost., Mon. pl. 8, 131, 146, 149, 150; Lister, Mycet. ed. 3. pl. 83, a-e; Macbr. & Martin, Myxom. pl. 9, f. 196, 197; Hattori, Myxom. Nasu pl. 10, f. 5; Jour. Ind. Soc. Bot. 33: 185. f. A-J.

EXSICCATI: Ellis, N. Am. Fungi 615; Jaap, Myxom. Exs. 67, 170; Cavara, Fungi Longob. 51.

The apparently sessile fruitings are often borne on very short stalks completely hidden from lateral view. What appear to be short plasmodiocarps when seen from above may, on close examination, usually be found to be composed of two or more sporangia, each with its separate stalk, which have fused in development.

The fruitings look like minute mushrooms. Didymium clavus is of about the same size and shape but differs in its single peridium covered with crystalline lime.

Diderma imperialis Emoto, Bot. Mag. Tokyo 43: 172. 1929.

Sporangia clustered, semiglobose or depressed, umbilicate below, about 1 mm in diameter, mostly sessile, but often stalked, dusky neutral gray, total height of stalked forms 0.35 mm; peridium single, clear brown, incrusted with amorphous calcium granules; stalk, when present, dark brown, cylindrical or subulate, up to 0.15 mm in length; columella lacking; capillitium colorless, delicate, scantily branched, the threads about 0.17 μ in diameter, often bearing small calcium granules and wart-like, rounded, refractive thickenings; spores globose, bright violaceous brown, verrucose, 10 μ . Plasmodium unknown.

TYPE LOCALITY: Jimmuji, Kanigawa, Japan.

HABITAT: Bark of living Cryptomeria.

DISTRIBUTION: Known only from type collection. ILLUSTRATIONS: Bot. Mag. Tokyo 43: pl. 1, f. 4–6.

The description suggests a very distinct but decidedly inconspicuous species.

Diderma indicum Thind & Sehgal, Mycologia 56: 564. 1964.

FIG. 316 Plate XXXV Fructifications sessile, pulvinate or somewhat plasmodiocarpous, white, varying to violaceous above, mostly crowded and heaped into irregular clusters, surface uneven to smooth; sporangiate forms pulvinate, subglobose to irregular, 0.4–0.8 mm in diameter; plasmodiocarps short, straight or curved, irregular, 0.4–0.7 mm in diameter; peridium single, calcareous, thick, crustose, shell-like, brittle, white or tinted, usually roughened, sometimes smooth; dehiscence irregular; hypothallus not evident; columella prominent, large, pulvinate, globose or elongate, cream-colored to light brown, with a spongy or areolate surface, calcareous, occupying more than half of the sporogenous cavity; capillitium abundant, rigid or undulate, composed of sparingly branched and anastomosing dark brown threads with paler or hyaline expanded and anastomosing extremities, bearing prominent fusoid swellings, often also expanded at points of union; spores black in mass, yellowish brown by transmitted light, varying from globose to ellipsoid or irregular, very inconspicuously verrucose, 8.4–9.8 μ in diameter when globose, 9–11.2 × 7–8.4 μ when ovoid. Plasmodium unknown.

TYPE LOCALITY: Darjeeling, India.

HABITAT: On moss.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATION: Mycologia 56: 564, fig. 3.

Close to *D. niveum*, from which it differs in the heaped fructifications with the apparently single peridium, the fusoid swellings and membranous expansions on the capillitium, and the spore characters.

In our material of the type collection, the spores are somewhat irregular and suggest that the specimen was somewhat prematurely dried, but it gives an excellent idea of the habit and capillitial characters, which do not fit any previously described species.

Diderma lucidum Berk. & Br., Ann. Mag. Nat. Hist. III. 7: 380. 1861.

Chondrioderma lucidum (Berk. & Br.) Cooke, Myx. Brit. 42. 1877.

Sporangiate, scattered; sporangia subglobose, 0.6–0.8 mm in diameter, flattened beneath, stalked, orange or vermilion, glossy, dehiscing irregularly by 4–5 lobes which become pale at the margins; peridium double, the outer layer smooth, translucent, orange-yellow, with scanty deposits of crystalline lime on the inner side, closely attached to the yellow inner layer; stalk slender, subulate, brownish black, 0.2–0.5 mm high; columella obconic or subglobose, often short-stalked, limy, white or ochraceous; capillitium dark, reticulate, the threads often expanded at the junctions; spores black in mass, deep grayish brown by transmitted light, densely spiny, 13–15 μ in diameter. Plasmodium orange-yellow.

TYPE LOCALITY: Caernarvonshire, Wales.

HABITAT: On moss on wet rocks.

DISTRIBUTION: Wales, northern England; ?Ceylon.

ILLUSTRATIONS: Ann. Mag. Nat. Hist. III. 7: pl. 15, f. 9; Lister Mycet. ed. 3, pl. 98.

The bright orange sporangia on short stalks, the large, spiny spores and the coarse capillitium are the marks of this striking species, which is well illustrated in Lister's figure. The reference to its possible occurrence in Ceylon is explained in the Lister Monograph, ed. 2, p. 115, repeated in ed. 3, p. 100.

Chondrioderma carmichaelianum (Berk.) Cooke, as treated in Massee, Mon. 202. 1892, included both this species and D. radiatum.

Diderma lyallii (Massee) Macbr., N. Am. Slime-Moulds 99. 1899.

Chondrioderma lyallii Massee, Mon. 201. 1892.

Diderma niveum subsp. lyallii G. Lister, in Lister, Mycet. ed. 2. 105. 1911.

Sporangia subglobose or obovate, crowded, on a prominent white hypothallus, rarely scattered, 1–1.5 mm in diameter, white, cream-colored, or pale flesh-colored, often mottled, sessile or short-stipitate; peridium double, the outer layer firm, stout, encrusted with granular or sometimes scaly masses of lime, the inner layer close but separate, membranous or subcartilaginous, opaque, buff or pale flesh-colored; hypothallus well developed, venulose, white; stalk, when present, short, stout, furrowed, merging with the hypothallus; columella prominent, clavate, about half the height of the sporangium, creamy white to flesh-colored or pale brown; capillitium rigid, the threads purplish brown or pallid, branching and anastomosing freely, often widened at the nodes; spores black in mass, dark purplish brown by transmitted light, coarsely and irregularly spiny, the spines blunt and irregularly distributed, often in lines so that in some specimens they appear subreticulate, 14–17 μ in diameter. Plasmodium white.

TYPE LOCALITY: Fort Colville, Washington.
HABITAT: Plant litter in mountainous regions.

FIG. 317 Plate XXXV

FIG. 318 Plate XXXV DISTRIBUTION: Colorado, Idaho, Utah, Nevada, Washington, California; Sweden; central Europe in Alps; Chile.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 90; Macbr. & Martin, Myxom. pl. 9, f. 190, 191.

EXSICCATI: Jaap, Myxom. Exs. 129; Brândză, Myxom. Roum. 97(IA).

The large sporangia, sessile, or borne on thick white stalks which merge into the hypothallus, and the very large, dark, spiny spores distinguish this species. The spines are blunt and might be regarded as elongated warts; they are often up to $1.5~\mu$ long. The spore dimensions given refer to the bodies only.

Several authors have noted that the lime may be somewhat vitreous. This happens in other species, and is found in collections which may well have been long moist. Since the species is associated with borders of melting snow banks this could easily occur. It was this character of the wall that led Meylan (Bull. Soc. Vaud. Sci. Nat. 56: 321. 1927) to insist that D. lyallii belongs in the subgenus Leangium. The wall is, however, definitely calcareous, not cartilaginous.

Chondrioderma fallax Rost., Mon. 171. 1874, is cited in the Lister monograph as possibly an earlier name for this species. It is cited by Krzemieniewska, Sluz. 138. 1960, as a synonym but she retains the later epithet.

FIG. 319 Plate XXXV Diderma montanum (Meylan) Meylan, Ann. Cons. Jard. Genève 16: 311. 1913. Chondrioderma montanum Meylan, Bull. Soc. Bot. Genève 2: 262. 1910.

Sporangia scattered or grouped, subglobose or ovate, stalked, flattened or umbilicate beneath, or subglobose on a constricted base; pearl or pinkish gray to nearly white, smooth or slightly wrinkled, 0.6–0.8 mm in diameter; peridium typically double, the walls often separating, the outer wall calcareous; the inner wall membranous, reddish brown toward the base or throughout, but inner wall sometimes lacking; stalk short, usually stout, pale or bright yellow-brown, enclosing white lime granules, 0.1–0.8 mm high; columella prominent, white to brownish red, stalked; capillitium of slender purplish threads, branching and occasionally anastomosing toward the tips; spores black in mass, pale purplish brown by transmitted light, densely and minutely spinulose, 8–10 μ in diameter. Plasmodium probably white or pale yellow.

TYPE LOCALITY: Switzerland.

HABITAT: On mosses, leaves, and plant litter.

DISTRIBUTION: Great Britain, Scandinavia, Germany, France, Portugal, Rumania; eastern Canada and United States to Virginia and Colorado; California; not common.

ILLUSTRATION: Lister, Mycet. ed. 3. pl. 207. EXSICCATUS: Brândză, Myxom. Roum. 54(IA).

The var. album (Torrend) G. Lister, Mycet. ed. 3. 84. 1925, with white or bluish white sporangia and pale columellae, based on Chondrioderma radiatum var. album Torrend, Broteria 7: 168. 1907, and var. roseum Meylan, Bull. Soc. Vaud. Sci. Nat. 52: 450. 1919, with pale pink sporangia arising from a red plasmodium seem to be no more than extreme color variations.

The description as given above is broadened to include certain specimens from the mountains of the western United States. A specimen from California (Kowalski 4264) is nearly white, but faintly flesh-colored, with a white columella and no trace of an inner wall; another, from Colorado, has a very delicate, closely attached inner wall recognizable only by close examination. Both have the same delicate, pale capillitium, which breaks away readily from the columella. In view of the wide variation suggested by the named varieties, it seems best to retain

these in *D. montanum*, although adequate study of additional collections may demonstrate that a distinct species is involved.

Diderma mussooriense Thind & Manocha, Mycologia 56: 712. 1964.

Sporangiate, patelliform, sessile on a restricted base, crowded on a common white hypothallus, circular in outline, 0.5–0.8 mm in diameter, or more or less distorted by pressure; peridium double, the outer layer calcareous, crustose, white or pale fawn, the inner peridium membranous, fragile, closely applied to outer layer; hypothallus crustaceous, white, common to a group; columella subglobose, orange-brown, expanding at base to color entire base of sporangium; dehiscence circumscissile, the outer peridium separating at the margin and the upper part breaking away as a lid; capillitium profuse, dark, the threads branching and anastomosing somewhat sparsely, paler at extremities; spores black in mass, violaceous brown by transmitted light, minutely warted, 8–9 μ in diameter. Plasmodium unknown.

FIG. 320 Plate XXXV

TYPE LOCALITY: Mussoorie, India.

HABITAT: Plant litter.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATIONS: Mycologia 56: 713, f. 1, A-C.

The bowl-like sporangia with distinct lids falling off as wholes and exposing the bright columella and base, make this a distinctive and easily recognized species. The authors compare it with D. globosum but it really has little in common with that species. Aside from the striking habit, the spores, as they note, differ in color and markings. They also add in size, but that does not hold as D. globosum is delimited in the present treatment.

Diderma niveum (Rost.) Macbr., N. Am. Slime-Moulds. 100. 1899.

Chondrioderma niveum Rost., Mon. 170. 1874.

Chondrioderma physaroides Rost., Mon. 170. 1874.

Diderma albescens Phill., Grevillea 5: 114. 1877.

Chondrioderma albescens (Phill.) Massee, Mon. 209. 1892.

Sporangia gregarious or crowded, depressed-spherical, varying from sessile on a constricted base, 0.7–2.2 mm in diameter, to pulvinate, rarely elongate, approaching short plasmodiocarps, white or pale pinkish buff; peridium double, the outer layer crustaceous, chalky, smooth, fragile, the inner layer delicate, persistent, membranous and often iridescent, yellowish or orange below; hypothallus white, often abundant, sometimes scanty or none; columella large, globose or hemispheric, ochraceous to deep orange; capillitium abundant, elastic, the threads of two sorts, some purplish or dusky, coarse, uneven, with pale extremities, others delicate and colorless, often beaded with wart-like thickenings, all rather sparsely branched and anastomosing; spores black in mass, violet-brown by transmitted light, minutely roughened, (8-)9-11(-12) μ in diameter. Plasmodium white.

TYPE LOCALITY: France.

HABITAT: Dead twigs and plant debris, especially in mountainous regions. DISTRIBUTION: France, Sweden, Norway, Great Britain, Germany, Switzerland; in North America, Michigan, Colorado, Nevada and Alaska south to California.

FIG. 321 Plate XXXVI ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 89, a-c; Macbr. & Martin, Myxom. pl. 9, f. 192, 193.

The separation of *Diderma alpinum* from this species has clarified its definition. The two are obviously closely related, but *D. alpinum* is more plasmodiocarpous in habit, and when it is sporangial, the sporangia are more pulvinate, also the outer peridium is much rougher and irregular, and the spores tend to be larger, while *D. niveum* is more constantly sporangial in habit, the sporangia may be much larger without losing the subglobose form, the outer peridium is a smooth, densely compacted, calcareous crust, and the spores tend to be smaller.

In some specimens from Colorado collected at elevations of 9,000–10,000 feet, the lime is partially vitreous. Such specimens are old and weathered and in this case, as with other specimens from alpine regions, the suggestion is that the lime has been dissolved, possibly in repeated melting of the snowbanks, and has hardened on drying to a somewhat crystalline form.

Diderma ochraceum Hoffm., Deuts. Fl. 2: pl. 9, f. 2 b. 1795.

FIG. 322 Plate XXXVI Reticularia ochracea (Hoffm.) Poir., in Lam. Encyc. 6: 182. 1804. Chondrioderma ochraceum Schroet., Krypt.-Fl. Schles. 3(1): 124. 1885.

Sporangiate, sessile, the sporangia often on a constricted base, scattered or clustered, subglobose, 0.4–1 mm in diameter, the fructification varying to short, curved or annulate plasmodiocarps, deep ochraceous, rarely pale red; peridium double, the outer wall cartilaginous, nearly smooth, or wrinkled, bearing concolorous lime deposits, free from or adherent to the membranous, yellowish inner peridium; columella not strongly developed; capillitium abundant, the threads delicate, simple, or rarely branching, dark yellow-brown, often hyaline at the base; spores black in mass, dark yellow brown by transmitted light, minutely spinulose, 9–11 μ in diameter. Plasmodium lemon-yellow.

TYPE LOCALITY: Germany.

HABITAT: Mosses and liverworts in wet places.

DISTRIBUTION: Great Britain, Sweden, Germany, France, Switzerland, Rumania; Quebec, Massachusetts, Pennsylvania, Tennessee; Japan.

ILLUSTRATION: Lister, Mycet. ed. 3. pl. 95.

EXSICCATUS: Brândză, Myxom. Roum. 53(IA).

Our only American collection is from Hagelstein, part of the material mentioned in Mycet. N. A. p. 104. In the Brândză material here illustrated, many of the sporangia appear stipitate, but only because they are perched on the extreme tips of the leaves of the mosses on which they are fruiting.

A very distinctive species, well illustrated in Lister's figure, although we have been unable to see the purplish color of the spores as there depicted.

"Physarum ochraceum Hoffm." in Schroet., Krypt. Fl. 3(1): 130. 1886. The specific epithet was evidently based on that of Hoffmann's name, but the combination was not validly published, and was probably applied by Schroeter to a quite different species, probably Physarum conglomeratum.

Diderma platycarpum Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 69: 359. 1966.

Fructification white, plasmodiocarpous, broadly effused, up to 20 mm long and 10 mm wide, very thin, about 0.1 mm; peridium double, the outer layer, thin, white, brittle, calcareous, composed of closely compacted small granules, 0.5–1 μ in diameter, the inner layer separate, but close, membranous, brown, translucent; dehiscence by falling away of the outer peridium and irregular

rupture of the inner peridium; columella lacking but base of peridium pale orange-brown within; capillitium profuse, the threads delicate, dichotomously branched, with few anastomoses, nearly colorless, arising from base and attached to the inner peridium; spores dark brownish fuscous in mass, pale rosy gray by transmitted light, subglobose, minutely and delicately warted, some of the warts in clusters, $10-11~\mu$ in diameter. Plasmodium unknown.

TYPE LOCALITY: Bilthoven, Netherlands.

навітат: Dead leaves.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATION: K. Ned. Akad. Wet. Proc. C. 69: 359, f. 5, A-C.

The above description is that of the typical variety platycarpum. Nannenga-Bremekamp also describes the variety berkeleyanum, l. c. f. 5, D-H, differing in its more reddish, more prominently warted, and smaller spores, 6-7 μ in diameter, and in the presence of tubules which penetrate the plasmodiocarps much as do those of Didymium difforme var. repandum G. Lister. The variety is based on a specimen from Java at Kew, B. 10744, which is the type of Chondrioderma saundersii Berk. & Br. ex Massee, Mon. 209. 1892, also known from Japan.

As the author states, both of these forms are very close to Diderma effusum, of which they may represent extreme variants. We have plasmodiocarpous specimens referred to that species in which the fructification is quite as thin as are those of D. platycarpum, with spores in the 6-7 μ range, suggesting that D. effusum is either an extremely variable species, or that it includes two or more closely related species not yet satisfactorily delimited.

Diderma radiatum (L.) Morgan, Jour. Cinc. Soc. Nat. Hist. 16: 151. 1894.

Lycoperdon radiatum L., Sp. Pl. ed. 2. 1654. 1763.

Didymium stellare Schrad., Nov. Gen. Pl. 21. 1797.

Diderma stellare (Schrad.) Pers., Syn. Fung. 164. 1801.

Diderma umbilicatum Pers., Syn. Fung. 165. 1801.

Diderma crassipes Schum., Enum. Pl. Saell. 2: 196. 1803.

Reticularia umbilicata (Pers.) Poir., in Lam. Encyc. 6: 183. 1804.

Leangium stellare (Schrad.) Link ex S. F. Gray, Nat. Arr. Brit. Pl. 1: 572. 1821.

Cionium stellare (Schrad.) Spreng., Syst. 4(1): 529. 1827.

Cionium umbilicatum (Pers.) Spreng., Syst. 4(1): 529. 1827.

Diderma carmichaelianum Berk., in Smith, Engl. Fl. 5(2): 311. 1836.

Diderma concinnum Berk. & Curt., in Berk., Grevillea 2: 52. 1873.

Chondrioderma radiatum (L.) Rost., Mon. 182. 1874.

Chondrioderma carmichaelianum (Berk.) Cooke, Myxom. Gr. Brit. 42. 1877.

Perichaena phaeosperma P. Karst., Rev. Myc. 9: 11. 1887.

Sporangia scattered, gregarious or crowded, globose or depressed-globose, sometimes umbilicate below and occasionally above, 0.6–1.4 mm in diameter, sessile on a contracted base or less commonly short-stalked, pale gray to brownish drab, often mottled or areolate; peridium obscurely double, the outer layer smooth, rugose, or corrugated, whitish or pale reddish brown within, usually darker at the base, closely applied to the membranous inner wall; dehiscence irregular above, stellate below, the lobes spreading radiately; columella large, calcareous, hemispheric to subglobose, pale cream-colored to orange or reddish brown; stalk, when present, short, thick, furrowed, more or less calcareous, pallid to reddish brown; capillitium abundant, the threads delicate, brown, pallid

FIG. 323 Plate XXXVI at the tips, sparsely branched and anastomosed except at the tips; spores often forming a compact dense black mass remote from the peridium but not enclosed by a membrane, purplish brown by transmitted light, distinctly, often irregularly warted, 9–12 μ in diameter. Plasmodium white or yellowish.

TYPE LOCALITY: Sweden.
HABITAT: Dead wood.
DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Schrad. Nov. Gen. Pl. pl. 5, f. 3, 4; Rost. Mon. pl. 9, f.
152, 155, 156; Lister, Mycet. ed. 3. pl. 93, 94, a, b; Macbr. & Martin,
Myxom. pl. 9, f. 204-205; Hattori, Myxom. Nasu, pl. 10, f. 1.

EXSICCATI: Jaap, Myxom. Exs. 90, 130, 150, 191; Jaap, Myxom. Exs. Nachl. 2: 6; Brândză, Myxom. Roum. II. 2: 32(NY); 51, 98, 99(IA).

This species is not entirely satisfactorily defined. As it occurs in the western mountains of North America, it is sessile or short-stalked, very similar to European (British?) specimens sent by A. Lister to Macbride, Morgan and Wingate, and to most other European collections we have. Our specimens do not have the long stalks shown in the Lister figures cited, and are not as dark nor as strongly mottled as is shown in fig. 94a of the Monograph, ed. 3. The var. umbilicatum (Pers.) G. Lister, Mycet. ed. 3. 96. 1925, is based on Meylan's treatment of D. radiatum and related species in Ann. Cons. Jard. Genève. 15–16: 311–313. 1913. Meylan regarded D. umbilicatum as distinct and divided it into the var. flavogenitum Meylan (invalid under present rules), with greenish gray sporangia arising from a yellow plasmodium and var. album (Torrend) Meylan, based on Chondrioderma radiatum var. album Torrend, Broteria 7: 168, 1907, with white sporangia arising from a whitish plasmodium. There may be two species involved, but the published record suggests that the variations noted do not transcend those to be expected in a species.

The var. rubrum Rönn, Schrift. Nat. Ver. Schl.-Holst. 15: 59. 1911, with pinkish sporangia and pink lime and said to arise from a coral-red plasmodium may be another color phase.

Probably associated with the compactness of the mass in which they are formed, the spores in the same sporangium may vary in size and shape and there is much difference in this respect between collections. After the spores and capillitium have been dispersed, the peridium expands into stellate rays, exposing the white inner surface and surrounding the large columella in the center. They are then very conspicuous against the dark background upon which fruiting has occurred, justifying the epithets radiatum and stellare.

In the United States and Canada *D. radiatum* is apparently uncommon in the east, but we have numerous collections from Colorado to the Pacific Coast, a substantial proportion of them over-mature for the reason given.

Diderma roanense (Rex) Macbr., N. Am. Slime-Moulds 104. 1899. Chondrioderma roanense Rex, Proc. Acad. Phila. 45: 368. 1893.

FIG. 324 Plate XXXVI

Sporangia scattered, stalked, depressed-hemispherical to discoid, thin, sometimes slightly concave above, 0.6–1.2 mm in diameter, usually shorter than wide, purplish brown or umber, mottled with paler lines of dehiscence; peridium double, the outer layer smooth, cartilaginous, white within, more or less adherent to the membranous, white, punctate inner layer; dehiscence irregular or somewhat stellate; stalk short, black, furrowed, variable in thickness; columella large, flat, discoid, ochraceous to brownish; capillitium sparse, delicate, the threads pale yellowish or colorless, sinuous, scantily forked and anastomosing; spores dark blackish brown in mass, smoky yellow-brown by transmitted

light, minutely but distinctly warted, 10–12 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Roan Mountain, Tennessee.

HABITAT: Dead wood.

DISTRIBUTION: Maine to Ontario, North Carolina, and Colorado.

ILLUSTRATION: Lister, Mycet. ed. 3. pl. 94, c. d.

Our scanty portion of the type agrees very closely with Lister's figure cited, except that it is less purple and the spores are not at all purple. Our few other specimens are weathered and unsatisfactory. The species is evidently rare, but appears to be distinctive.

Diderma rugosum (Rex) Macbr., N. Am. Slime-Moulds 105. 1899.

Chondrioderma rugosum Rex, Proc. Acad. Phila. 45: 369. 1893.

Sporangia scattered, stalked, subglobose, 0.4-0.5 mm in diameter, white or cinereous with a brownish base, rarely exceeding 1 mm in height; peridium single, cartilaginous, thin, scantily charged with lime, reticulately wrinkled, the ridges marking the lines of dehiscence into irregular, polyhedral fragments; stalk usually well developed, subulate, furrowed, black, 0.4-0.8 mm high; columella clavate, rugose, white or pale ochraceous, often attaining half the height of the sporangium; capillitium delicate, the threads pale yellow-brown fading to nearly colorless toward the ends, forking and anastomosing to form a loose net attached to the base of the sporangium and the columella below and to the peridium at their tips; spores dark brown in mass, yellow-brown by transmitted light, minutely warted, 8-10(-12) μ in diameter. Plasmodium gray.

TYPE LOCALITY: Cranberry, North Carolina.

HABITAT: Dead leaves and mosses.

DISTRIBUTION: New York to Florida and the West Indies, west to Iowa; Europe; Asia.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 86; Macbr. & Martin, Myxom. pl. 9, f. 210, 211; Hattori, Myxom. Nasu, pl. 10, f. 3.

EXSICCATUS: Brândză, Myxom. Roum. 95(NY).

The small, stalked sporangia with the white, reticulately rugose heads, usually growing on mosses, are readily recognized when known. The species seems to be rather rare, but the fruitings are usually small and inconspicuous and may be overlooked.

The description of the var. asiatica Skvortz., Philipp. Jour. Sci. 45: 88. 1931, does not make it appear to be distinctive enough to deserve a name.

Diderma sauteri (Rost.) Macbr., N. Am. Slime-Moulds. 103. 1899.

Chondrioderma sauteri Rost., Mon. 181. 1874.

Chondrioderma aculeatum Rex, Proc. Acad. Phila. 43: 390. 1891.

Sporangia scattered, gregarious, sessile, subglobose or lenticular, 0.6–1 mm in diameter, ochraceous, pinkish gray or pale reddish brown; peridium double, the outer layer cartilaginous, thin, smooth or occasionally wrinkled, rupturing irregularly, remote from the thin, semi-transparent grayish or sometimes iridescent inner layer; hypothallus not apparent; columella small and scarcely evident, often reduced to a thickened, brownish red, rugose base; capillitium

FIG. 325 Plate XXXVI scanty, the threads pale violaceous or colorless except at the reddish brown bases which often adhere to the columella and cause it to appear spiny; spores black in mass, dark brown by transmitted light, spinulose, 12–13 μ in diameter. Plasmodium white.

TYPE LOCALITY: Austria.

HABITAT: Mosses and mossy logs.

DISTRIBUTION: Scotland, Austria, Rumania; in North America, Maine to

Quebec, south to Pennsylvania, very rare. ILLUSTRATION: Lister, Mycet. ed. 3. pl. 96.

Closely related to *D. ochraceum*, from which it is separated by the pinkish color, the pale capillitium, and the larger, darker and rougher spores.

FIG. 326 Plate XXXVI Diderma simplex (Schroet.) G. Lister, in Lister, Mycet. ed. 2. 107. 1911. Chondrioderma simplex Schroet., Krypt.-Fl. Schles. 31: 123. 1885.

Sporangia gregarious, sessile, crowded or heaped, 0.2–0.8(-1) mm in diameter, subglobose, pulvinate or depressed, rarely plasmodiocarpous, brown or brick-red to ochraceous, sometimes bright yellow; peridium single, calcareous, rugulose or smooth; columella usually little more than a thickened base, sometimes dome-like and with a space between the bottom and the hypothallus; hypothallus concolorous, sometimes extensive; capillitium scanty, delicate, the threads slender, pallid to tinted; spores dark brown in mass, pale violaceous brown by transmitted light, minutely warted or spiny, sometimes with clusters of larger warts, $(8-)9-11~\mu$ in diameter. Plasmodium orange-brown.

TYPE LOCALITY: Silesia.

HABITAT: Mosses and leaves in moist habitats, rarely on wood.

DISTRIBUTION: Great Britain, France, Germany, Rumania; in North America, Maine to Ontario and Wisconsin, south to Florida; Chile; Japan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 88; Hattori, Myxom. Nasu pl. 10, f. 3.

The variety echinulatum Meylan (Bull. Soc. Vaud. Sci. Nat. 52: 450. 1919) is recognized by Lister and Hagelstein for forms with bright yellow sporangia and spiny spores. It is possible that it is sufficiently distinct to be regarded as a separate species, as Meylan suggests.

The rather brittle wall is composed of closely agglutinated lime granules. There is no trace of an inner wall. The species is rare in the United States. While most of our specimens are brick-red, two are clear, bright, pale ochraceous. We have seen none which could be called yellow. A. Lister (Jour. Bot. 33: 324. 1895) reports on a collection in which the capillitium was beaded with brown granules.

Although widely distributed, the species is rather rare, certainly in North America.

FIG. 327 Plate XXXVI Diderma spumarioides (Fries) Fries, Syst. Myc. 3: 104. 1829.

Didymium spumarioides Fries, Symb. Gast. 20. 1818. Not D. spumarioides Fries 1829.

Physarum stromateum Link, Handb. 3: 409. 1833.

Carcerina spumarioides (Fries) Fries, Summa Veg. Scand. 451. 1849.

Chondrioderma spumarioides (Fries) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27–28: 74. 1873.

Chondrioderma stromateum (Link) Rost., Mon. App. 18. 1876.

Chondrioderma virgineum Massee, Mon. 207. 1892.

Diderma stromateum (Link) Morgan, Jour. Cinc. Soc. Nat. Hist. 16: 152. 1894.

Sporangia sessile, white or pale ochraceous, globose, 0.4–0.8 mm in diameter, gregarious or more commonly crowded and often deeply imbedded in the profuse white or creamy hypothallus, and distorted by pressure, smooth or rugose, sometimes, especially in tropical collections, areolate; peridium double, the outer layer rough, densely calcareous, fragile, closely applied to the membranous dull gray inner layer; columella convex or hemispheric, rarely cylindric or digitate, or forming free, fusiform, calcareous accretions mingled with the capillitium, white, ochraceous, or pale flesh-colored; capillitium usually abundant, the threads brown, rather sparsely branching and anastomosing, the tips paler; spores black in mass, rather pale yellow-brown by transmitted light, minutely warted, 8–11 μ in diameter. Plasmodium white.

TYPE LOCALITY: Europe.

HABITAT: Dead leaves and forest litter, less commonly on wood or living plants.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 84, Hattori, Myxom. Nasu pl. 11, f. 5.

EXSICCATI: Ellis & Ev., Fungi Columb. 1399; Jaap, Myxom. Exs. 104, 125, 148; Brândză, Myxom. Roum. II. 2: 31(NY); Thaxter, Rel. Farl. 386.

As both the Listers and Hagelstein noted, *D. spumarioides* and *D. globosum* are connected by intermediate forms and early authors, not studying microscopic characters, probably confused them. *D. crustaceum* and *D. cinereum* must be added to the complex. It may be that they all represent phases of a common, widespread and variable species. However, most collections show the difference in spore size, associated with the widely separated or close peridial layers. If they are to be united it would have to be as *D. globosum*.

Morgan segregated specimens with large, rather smooth-walled sporangia aggregated on a conspicuous common white hypothallus as *Diderma stromateum*. Of the eight specimens so labelled by him, and now in the Iowa collection, one is a *Physarum*, but the others appear to belong here.

Diderma concavum Emoto, Proc. Imp. Acad. Tokyo 11: 445, p. 446, f. 3–6. 1935, is described as very similar to D. spumarioides but differing in the sporangia, which are sunken in the middle, making them appear annulate, and in the small, 7–9 μ , pale spores. Similar fruitings are known in other species and this, apparently based on a single collection, may be an aberrant fruiting of this or a related species.

Reticularia sphaeroidalis Bull., Hist. Champ. Fr. 1: 94. 1791; Spumaria physaroides Pers., Syst. Fung. 163. 1801; Physarum physaroides (Pers.) Chev., Fl. Par. ed. 2. 1: 339. 1836, may belong here. The early students not unnaturally confused this species with Mucilago crustacea and the synonymy is correspondingly confused. Fries, Syst. Myc. 3: 104, 121. 1829, makes it quite clear that his Didymium spumarioides of 1818 was included in his Didymium spumarioides of 1829, now equated with Mucilago crustacea, while his Didymium spumarioides of 1829 was something different, although his citation of Spumaria mucilago Pers. as a synonym of the latter, would also suggest Mucilago. In view of the confusion, a strong case could be made for the adoption of Link's specific epithet for the species, as was done by Rostafinski and Morgan, even though both authors believed D. stromateum was distinct from D. spumarioides.

In large fruitings on leaves, great variation may be found in sporangia obviously from the same plasmodium but matured at different rates, those on top having dried more rapidly than those immersed in the leaves. In such fruitings some sporangia may appear to have widely separated walls. Careful examination will often show that the walls are not separated and that the agglutinated mass of spores in the center is not surrounded by a membrane. This is often reflected in spore characters; in such fruitings the spores may be unusually large and pale and obviously not fully matured. These, and similar aberrations in fruiting must be taken into consideration in studying these difficult forms.

FIG. 328 Plate XXXVI Diderma subdictyospermum (Rost.) G. Lister, Mycetozoa ed. 2. 101. 1911.

Chondrioderma subdictyospermum Rost., Mon. App. 16. 1876.

Chondrioderma dealbatum Massee, Mon. 207. 1892. (as dealbata).

Sporangia crowded, sessile, subglobose or hemispherical, 0.3–0.5 mm in diameter, snow-white, usually seated on a white hypothallus; peridium double, the outer wall thick, fragile, closely adherent to the membranous inner walls; columella hemispherical or subglobose, white; capillitium abundant, the threads dark purplish brown, rigid, sparingly branched, anastomosing toward the peridium; spores brown, subreticulate or reticulate, the ridges about 2 μ high, 10–12 μ in diameter including the ridges. Plasmodium unknown.

TYPE LOCALITY: Venezuela.

HABITAT: Dead leaves and moss.

DISTRIBUTION: Venezuela; South Africa; Ceylon; Java. ILLUSTRATION: Lister, Mycet. ed. 3, pl. 87, f. d–f.

The type was collected by Fendler in Venezuela, but seems not to have been included in his Venezuela Fungi. Portions of it are at Kew, at the British Museum and at the New York Botanical Garden and also two scanty portions at Iowa, one from the New York specimen sent by Seaver, the other sent by Massee to Wingate. A. Lister, Mycet. 77. 1894 reported an additional collection from South Africa;

G. Lister, Mycet. ed. 2. 101. 1911, added Java, and in Mycet. ed. 3. 83, Ceylon. As noted by these authors, the reticulation on the spores of the type collection is incomplete, but more nearly complete on the others. Our material is too shattered to permit a good habit sketch, but the spores and capillitium are distinctive. Massee says "dehiscence circumscissile" and that is suggested by the Lister drawing. "Diderma dealbatum Berk. & Curt." ex. Massee, cited in his monograph as the basionym of Chondrioderma dealbatum, was never validly published. Rostafinski cited it as "B. msc."

Diderma subincarnatum Kowalski, Mycologia 59: 169. 1967.

Sporangiate, sessile, densely crowded, dingy flesh-colored to dark pinkish brown, often mottled, hemispherical or pulvinate on a constricted base, 0.5–1 mm in diameter; peridium double, the outer layer calcareous, thick, fragile, somewhat paler within, inner layer membranous, closely appressed, colorless or sometimes flecked with white limy patches; columella large, up to 0.5 mm in diameter, subglobose to hemispherical, rugose to tuberculate, cream to flesh-colored; capillitium rigid, radiating from columella to peridium, where it is attached, the threads dark brown at base becoming paler toward extremities where they are light brown or pallid, sparsely branched and anastomosing, sometimes with membranous expansions in the axils; spores globose, black in mass, dark brown by transmitted light, paler on one side, spinulose, I3–15 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Butte Co., California.

HABITAT: Dead leaves.

DISTRIBUTION: California.

ILLUSTRATIONS: Mycologia 59: 169, f. 1, 2.

This is the species reported by Plunkett (1934) as *Diderma antarcticum* (Speg.) G. Lister, based on *Licea antarctica* Speg. It cannot, however, be that species, which has a cartilaginous peridium and smaller spores.

Diderma testaceum (Schrad.) Pers., Syn. Fung. 167. 1801.

Didymium testaceum Schrad., Nov. Gen. Plant. 25. 1797.

Cionium testaceum (Schrad.) Spreng., Syst. 4(1): 529. 1827.

Diderma cubense Berk. & Curt., Jour. Linn. Soc. 10: 347. 1868.

Diderma sublateritium Berk. & Br., Jour. Linn. Soc. 14: 82. 1873.

Chondrioderma testaceum (Schrad.) Rost., Mon. 179. 1874.

Diderma mariae-wilsonae Clinton, in Peck, Ann. Rep. N. Y. State Mus. 26: 74. 1874.

Chondrioderma sublateritium (Berk. & Br.) Rost., Mon. App. 19. 1876.

Chondrioderma cubense (Berk. & Curt.) Rost., Mon. App. 19. 1876.

Sporangia gregarious, sessile, hemispheric or depressed-globose, 0.7–1 mm in diameter, rarely on a short, thick stem, pale flesh-colored or pinkish, rarely pale brownish red, often fading to white; peridium double, the outer layer thick, crustaceous, polished, pinkish within, the inner layer separate but close, thin, membranous, often wrinkled, ashen or pinkish gray; columella prominent, convex, slightly roughened, pinkish brown or alutaceous; hypothallus thin, delicate, often scarcely evident; capillitium abundant, the threads delicate, smooth, little-branched, pale or colorless; spores black in mass, light brown by transmitted light, nearly smooth, 8–9 μ in diameter. Plasmodium yellowish buff.

TYPE LOCALITY: Germany.

HABITAT: Dead leaves and plant debris in moist habitats.

DISTRIBUTION: Throughout temperate North America; Europe; Ceylon; Japan.

ILLUSTRATIONS: Schrader, Nov. Gen. Plant. pl. 5, f. 1-2; Lister, Mycet. ed. 3. pl. 87, a-c; Nat. Geogr. Mag. 49(4), pl. 12; Hattori, Myxom. Nasu pl. 11, f. 6.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2093; Jaap, Myxom. Exs. 27, 68, 106; Brândză, Myxom. Roum. I. 1: 11; 35(NY); 50(IA); Thaxter, Rel. Farl. 393.

Nearly all collections appear pinkish in the field; some lose their color rapidly after collection, while others have retained it for a half century. The inside wall of the outer peridium is apparently always distinctly colored. Our darkest collection, about vinaceous tawny of Ridgway, was collected in 1892.

Schrader's original illustration is excellent and can apply to nothing else.

Diderma trevelyani (Grev.) Fries, Syst. Myc. 3: 105. 1829.

?Didymium geaster Link, Ges. Natur. Fr. Berlin Mag. 7: 42. 1815.

Leangium? trevelyani Grev., Scot. Crypt. Fl. pl. 132. 1824.

Cionium trevelyani (Grev.) Spreng., Syst. 4(1): 529. 1827.

Chondrioderma trevelyana (Grev.) Rost., Mon. 182. 1874.

Polyschismium trevelyani Corda ex. Rost., Mon. 182. 1874.

Chondrioderma oerstedtii Rost., Mon. 184. 1874.

ғіс. 330 Plate XXXVII

FIG. 329

Plate XXXVI

Diderma geasterodes Phill., Grevillea 5: 113. 1877.

Diderma laciniatum Phill., Grevillea 5: 113. 1877.

Didymium subcastaneum Romell, Fungi Scand. 100. 1885.

Chondrioderma geasteroides (Phill.) Massee, Mon. 201. 1892.

Lepidoderma geaster (Link) Morgan, Jour. Myc. 9: 3. 1903.

Sporangia scattered or clustered, globose or nearly so, 0.8-1.5 mm in diameter, sessile on a constricted base or stalked, yellow-brown to reddish brown, sometimes paler or darker, the peridium usually marked by pale areas of dehiscence into more or less hexagonal patches, rarely plasmodiocarpous; peridium triploid, the outer layer cartilaginous, firmly attached to the middle layer, which is composed of coarse, crystalline or subcrystalline lime granules, at maturity dehiscing together in fragments above, in stellate rays below, the delicate membranous inner layer enclosing the spores and capillitium quickly evanescent; stalk, when present, usually short, thick, opaque, rarely equalling the sporangium in height and then relatively slender; hypothallus dark, inconspicuous, often scarcely evident, sometimes lightly sprinkled with lime; columella variable, sometimes large, subglobose, on a delicate pedicel, often small, or reduced to a free ball of subcrystalline lime in the center of the spore mass, usually disappearing with the spores; capillitium profuse, the threads coarse, dark brown, often bearing nodular accretions, profusely branched and anastomosing, attached to columella and peridium; spores black in mass, dark brown by transmitted light, minutely warted, (10-)11-12(-13) μ in diameter. Plasmodium yellow-brown.

TYPE LOCALITY: Scotland.

HABITAT: Dead wood, particularly of conifers, often fruiting on mosses.

DISTRIBUTION: Western and central Europe; Virginia, Ohio, Colorado to the Pacific, particularly in mountainous areas.

ILLUSTRATIONS: Grev., Scot. Crypt. Fl. pl. 132; Grevillea 5: pl. 87, f. 1, 2; Lister, Mycet. ed. 3. pl. 91.

EXSICCATI: Romell, Fungi Scand. 100; Jaap, Myxom. Exs. 149.

The most distinctive character of this species is the middle layer of the sporangium composed of large crystalline granules firmly imbedded in the matrix and firmly united to the outer layer. After dehiscence the two outer layers become flattened against the substratum and are then very conspicuous against the background, hence this is the stage in which it is usually collected. The capillitium is also quite different from that of most species of the genus. The areolate markings are usually very conspicuous but are sometimes lacking, as was evidently the case in the specimens illustrated by Greville and by Lister.

The variety nivale Meylan, Bull. Soc. Vaud. Sci. Nat. 50: 189. 1914, as represented in our collection by Jaap's No. 149, collected and named by Meylan, and two additional boxes, one of which may be a part of the same material supplied to Jaap, is large, some of the unopened sporangia slightly exceeding 2 mm in diameter, pale tan, with paler, slightly raised lines of dehiscence, but scarcely rugose.

Fries, in publishing this as a *Diderma*, cited *Didymium geaster* Link as a synonym. Rostafinski, Mon. 182. 1874, cited Link's species as a synonym of what is now called *D. radiatum*. Morgan found a specimen of *D. trevelyani* in Ohio bearing crystalline scales of lime and believing it was Link's species, transferred it to *Lepidoderma*. We have a specimen collected by Morgan in Ohio in 1900 and labelled in his hand "*Lepidoderma geaster* Link" which very probably is the specimen on which he based his name. We have other specimens in which the scales are even more conspicuous on some of the sporangia, but they appear no different from similar scales which occasionally occur in other species with limy

peridia. It is doubtful whether Link's species can be recognized from his description.

Greville characterized his species as "the most elegant of the minute Gastromyci I ever beheld." At its best, it is certainly most attractive. Those who wish to follow Art. 73, Note 3, of the current Code will write the specific epithet "trevelyanti." This seems unnecessarily uncouth and we exercise the option of not following the recommendation in such instances.

EXCLUDED AND DOUBTFUL SPECIES

"Chondrioderma cookei Massee, in Herb. Kew."

Cited by Massee, Mon. 207. 1892, as synonym of *C. virgineum* Massee, q. v. under *D. spumarioides*. Not validly published; presumably only a reference to a misdetermined species.

Chondrioderma friesianum Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27-28: 74. 1873.

Originally said to be close to *D. testaceum*; later referred to other species as a possible synonym. Uncertain.

Chondrioderma frustulosum Pat., Bull. Herb. Bois. 3: 61. 1895. n.v.

Brief description in Sacc., Syll. Fung. 11: 464. 1895. Cited in editions 2 and 3 of Lister monograph as doubtful synonym of *D. globosum*. Uncertain.

Chondrioderma leptotrichum Racib., Rozp. Akad. Umiej. 12: 75. 1884.

Cited by G. Lister, Mycet. ed. 3. 118. 1925, as possible synonym of Didymium squamulosum.

Chondrioderma mutabile Schroet., Krypt. Fl. Schles. 3(1): 123. 1885.

Cited in Lister, Mycet. ed. 3. 90. 1925, as a possible synonym of *Diderma deplanatum*.

Chondrioderma puiggari Speg., Bol. Ac. Nac. Cienc. Cordoba 11: 475. 1889.

Cited by G. Lister, Mycet. ed. 3. 92. 1925, as possible synonym of *Diderma simplex*.

Chondrioderma stahlii Rost., Mon. 185. 1874.

Recognized by Berlese, Cooke and Massee, but descriptions might apply to various species. A. Lister, Mycet. 88. 1894, said it suggested a form of *C. radiatum*. See also G. Lister, ed. 3. 97.

Diderma acuminatum Schum., Enum. Pl. Saell. 2: 198. 1803.

Doubtful. G. Lister, Mycet. ed. 3. 259. 1925.

"Diderma compactum Wallr. Herb."

Cited by Rost., Mon. 99. 1874, as synonym of *Physarum schumacheri* Spreng.; "p.p." in index. Not validly published.

"Diderma deplanatum Fuckel non Fries," Jahrb. Nass. Ver. Nat. 23-24: 341.

Cited by Rost., Mon. 179. 1874, as synonym of *C. calcareum* (Link) Rost. Not validly published. Fuckel cited Fries as author. See Fuckel's correction, l.c. 27-28: 74. 1873.

Diderma depressum Fries, Syst. Myc. 3: 108. 1829.

Cited by Rost., Mon. 172. 1874, as synonym of *Chondrioderma michelii* (Lib.) Rost. Questioned by A. Lister, Mycet. 79. 1894 and later editions of monograph.

"Diderma difforme Alb. & Schw., Consp. Fung. 90. 1805."

Cited by S. F. Gray, Nat. Arr. Brit. Pl. as synonym of "D. muricola Link" (error for D. muscicola); by Fries, Syst. Myc. 3: 109. 1829, as synonym of D. cyanescens Fries. Not listed by Albertini and Schweinitz under new species and their intent was obviously to refer to D. difforme Pers.

Diderma farinaceum Peck, Ann. Rep. N. Y. State Mus. 26: 74. 1872.

Cited by Massee, Mon. 233. 1892, as synonym of *Didymium spumarioides* Fries 1818, not Fries 1829, here regarded as a synonym of *Diderma spumarioides* (Fries) Fries 1829. See also Berlese, in Sacc., Syll. 7: 367. 1888.

"Diderma lenticulare Wallr. Herb."

Cited as synonym of *Chondrioderma michelii* (Lib.) Rost. Mon. 172. 1874, "p.p." in index. Probably not validly published.

Diderma lobatum Somm., Suppl. Fl. Lapp. 240. 1826.

Cited by G. Lister, Mycet. ed. 3. 116. 1925, as possible synonym of Didymium nigripes var. xanthopus.

Diderma macrosporum Krzem., Polsk. Akad. Umicj. 67: 131. 1933.

Characterized by its very large spores, 15–17 μ in diameter. Not listed in Krzemieniewska 1960. Close to if not a variant of *D. chondrioderma*.

Diderma microcarpum Meylan, Bull. Soc. Vaud. Sci. Nat. 55: 240. 1924.

Close to D. alpinum and D. globosum. Possibly distinct, but also possibly a small form of either.

"Diderma muricolum Link," S. F. Gray, Nat. Arr. Brit. Pl. 1: 571. 1821.

Typographical error for following, with change in declension.

Diderma muscicola Link, Ges. Nat. Freunde Berlin Mag. 3: 26. 1809.

Cited by Rostafinski, Mon. 155. 1874 as synonym of Didymium farinaceum Schrad.

Diderma nanum Fries, in Weinm., Fl. Ross. 577. 1836.

Doubtful. G. Lister, Mycet. ed. 3, 259, 1925.

"Diderma pallidum Berk. & Curt.," Grevillea 2: 52. 1873.

Cited by Rostafinski, Mon. 112. 1874, as a synonym of *Physarum sinuosum*, followed by later authors. In the reference given Berkeley cited it as a synonym of the same species, which he called *Angioridium sinuosum*. Massee (1892) also cited it, but only to exclude it explicitly from the synonymy of that species. So far as we can discover, never validly published.

"Diderma physaroides Schum. Herb."

Cited by Rost., Mon. 172. 1874, as synonym of *Chondrioderma michelii* (Lib.) Rost.; "p.p." in index. Not validly published.

Diderma rufipes (Alb. & Schw.) Fries, Syst. Myc. 3: 101. 1829.

Based on *Physarum aurantiacum* var. rufipes Alb. & Schw., Consp. Fung. 94. 1805. Cited by Rost., Mon. 99. 1874, as synonym of *Physarum schumacheri* Spreng.; "p.p." in index.

Diderma trichodes (Link) Fries, Syst. Myc. 3: 108. 1829.

Based on *Didymium trichodes* Link, a discomycete according to Berlese, in Sacc., Syll. 7: 386. 1888.

"Diderma umbilicatum Peck."

As cited in Sacc., Syll. 7: 372. 1888, and elsewhere, probably an error for D. umbilicatum Pers.

Leangium physaroides Link, Ges. Nat. Freunde Berlin Mag. 3: 26. 1809.

Said by author to be intermediate between *Leangium* and *Physarum*. Not identifiable from description.

Leangium umbilicatum Rab., Deuts. Crypt. Fl. 1: 285. 1844. n.v.

Cited by Rost., Mon. 183. 1874, as synonym of *Chondrioderma radiatum* (L.) Rost. Probably based on *Diderma umbilicatum* Pers. If so, a synonym of *D. radiatum* q.v.

Mucilago

Micheli ex Batt., Fung. Hist. 76. 1755.

Spumaria Pers., in J. F. Gmel., Syst. Nat. 2: 1466. 1791.

Fructification aethalioid, pulvinate, usually large, consisting of numerous anastomosing tubes filled with spores and capillitium, covered by a dense, calcareous, crystalline cortex, with a delicate, membranous inner cortex. Capillitium slender, limeless. Pseudocapillitium membranous, limy, composed of the walls of the constituent plasmodial strands. Spores black in mass.

Type species, Mucilago crustacea alba Mich.≡M. crustacea Wiggers.

There has been some question whether *Mucilago* or *Spumaria* is the correct name for this genus. Both are based on Micheli's species, as illustrated in his pl. 96, f. 2. Battarra was the first to use *Mucilago* after 1753 and his pl. 40, H and I

may well refer to this genus; G of the same plate suggests one of the Diderma spumarioides group but could apply to some fruitings of Mucilago. It is not surprising that these forms and certain phases of Fuligo septica were confused at that time and for long after. Persoon's original description of Spumaria is equally inconclusive. It was not until Morgan (1897) published his paper on the synonymy and proposed the combination Mucilago spongiosa that Mucilago replaced Spumaria in general use, stimulated by Macbride's adoption of the name in the first edition of the North American Slime-Moulds (1899) and G. Lister's acceptance of it in the second edition of the Mycetozoa (1911). Even then, it was not universally accepted and Jahn (Ber. Deuts. Bot. Ges. 41: 390-393. 1923) published a vigorous attack on Morgan's conclusions, in which he emphasized the fact that many of the earlier authors had restricted Mucilago to the plasmodial stage. This is doubtless true. Battarra was the first to use Mucilago after 1753, and he cites Mucilago crustacea alba Micheli, Nova Pl. Gen. 216, pl. 96, f. 2, which certainly suggests Mucilago rather than Fuligo. The earliest use of the name in a binomial combination is that of Wiggers, Prim. Fl. Holsat. 112. 1780, in which Wiggers, in this case, indicated the specific epithet in italics followed by four words of description and a reference to Haller. If this is not binomial nomenclature, then the universally accepted name Fuligo septica, on the same page, must be discarded with it.

A single species.

Mucilago crustacea Wiggers, Prim. Fl. Holsat. 112. 1780. Not M. crustacea (L.) Schrank 1789.

Mucor spongiosus Leysser, Fl. Hal. ed. 2. 305. 1783.

Reticularia alba Bull., Hist. Champ. Fr. 92. 1791.

Spumaria mucilago Pers., in J. F. Gmel., Syst. Nat. 2: 1466. 1791.

Spumaria alba (Bull.) DC., Fl. Fr. 2: 261. 1805. Not S. alba Schum. 1803.

Didymium spumarioides Fries, Syst. Myc. 3: 121. 1829, Not 1818.

Diderma spumariaeforme Wallr., Fl. Crypt. Germ. 2: 374. 1833.

Mucilago spongiosa (Leyss.) Morgan, Bot. Gaz. 24: 56. 1897.

Spumaria alba var. dictyospora R. E. Fries, Ark. Bot. 1: 66. 1903.

Spumaria alba var. solida Sturgis, Colo. Coll. Pub. Sci. 12: 29. 1907.

Spumaria solida (Sturgis) Jahn, Ber. Deuts. Bot. Ges. 41: 391. 1923.

Aethalium white to creamy or pale ochraceous, 1–7 cm long, 1–5 cm broad, 1–2 cm thick; cortex dense, spongy or pulverulent, composed of calcareous crystals which may be small or large but are usually of approximately equal size in a single fruiting; capillitium often profuse, of dark, branching and anastomosing threads forming an intricate network, often bearing dark concretions, or enlargements, varying to scanty and then often paler; pseudocapillitium composed of the walls of the constituent tubes, thin, hyaline, often iridescent; hypothallus strongly developed, horny, membranous or spongy, hyaline or white, often including dense masses of crystalline lime; spores black in mass, blackish brown or occasionally bright purple-brown by transmitted light, densely warted or spiny, rarely reticulate, (9–)11–13(–15) μ in diameter. Plasmodium creamy white or pale yellowish.

TYPE LOCALITY: Italy.

HABITAT: Dead wood and leaves and encrusting the stems of living plants. DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Micheli, Nov. Pl. Gen. pl. 96, f. 2; Batt., Fung. Hist. pl. 40, f. G-I; Bull., Herb. Fr. pl. 326; Greville, Scot. Crypt. Fl. pl. 267;

FIG. 331 Plate XXXVII Lister, Mycet. ed. 3. pl. 117; Univ. Iowa Stud. Nat. His. 14(8): pl. 4, f. 27, a, b; Macbr. & Martin, Myxom. pl. 7, f. 149, 150; Hagelst., Mycet. N. Am. pl. 10, f. 3.

EXSICCATI: Jaap, Myxom. Exs. 30; Hintikka, Myxogast. Fenn. 12; Brândză, Myxom. Roum. I. 1: 15, 41, 105(NY); 77(IA).

This extremely common and widely distributed species is rather variable in spore size, color and markings, in size of lime crystals and in consistency of the cortex and interior, but certainly no more so than other common and widely distributed species.

Fries (Syst. Myc. 3: 95. 1829) recognized two varieties. For the variety laminosa Fries he cited as synonyms Hallers No. 2134, Nees's f. 94 and Greville's f. 267 ("optime"). The last two certainly belong here. For the var. cornuta (Schum.) Fries, he cites Pers., Tent. Disp. Fung. pl. 1, f. 1. 1797 (n.v.), Spumaria cornuta Schum., Enum. Pl. Saell. 2: 195. 1803 (n.v.) and Hornemann, Fl. Dan. pl. 1978, f. 1. 1828. The last-named is surely the present species. Fries comments on the confusion and suggests that the genus may well include several species, making particular mention of Diderma spumarioides. His point is well taken, but in this case he was unable to resolve the problem.

Morgan (1894) cited the name as "Spumaria alba Bull." and recognized three varieties, the var. didymium (Fries) Morgan, based on Didymium spumarioides Fries 1818, not 1829, the var. cornuta (Schum.) Fries, and the var. mucilago (Nees) Morgan. G. Lister Mycet. ed. 2. 138. 1911, recognized the var. dictyospora R. E. Fries, and the var. solida Sturgis. The var. dictyospora is described as having an incomplete reticulatum on the spores. It was originally reported from Bolivia and later from England. We have a specimen from Minnesota which could go here, but it seems unworthy of a special name.

The var. solida has extremely compact aethalia and rather small spores. Jahn raised it to species rank, but here, too, the transition from the variety to the typical form is complete, so that it seems desirable to expand the definition of the species to include it.

Didymium

Schrad., Nov. Gen. Pl. 20. 1797.

Lepidodermopsis Höhn., Sitz.-ber. Akad. Wien 118: 438. 1909. Not Lepidodermopsis Wilcz. & Meylan 1934.

Sporangiate or plasmodiocarpous; peridium thin, membranous, covered with a more or less dense coating of calcareous crystals either scattered loosely over the surface or combined into a crust; columella usually present, sometimes reduced to a thickened, calcareous base; capillitium of branching and anastomosing, limeless threads often bearing dark, nodular thickenings; spores black in mass, violaceous or purplish brown by transmitted light.

Type species, Didymium farinaceum Schrad.

As defined in current usage, *Didymium* is separated from *Diderma* only by the crystalline nature of the lime on the peridium. When the lime crystals are loosely aggregated, as they are in most species, their nature may be inferred with reasonable assurance by examination with a hand lens. When they are united into a crust, only a microscopic mount will reveal their crystalline nature. And, as noted under *Diderma trevelyani*, there is a crystalline middle layer in the peridium of that species and crystals may be present in the stalk or hypothallus of other species of *Diderma*, suggesting that the distinction is somewhat arbitrary. However, it is taxonomically workable, which, in the present state of our knowledge of the Myxomycetes, justifies its retention.

Of the eight species included in Schrader's original treatment of the genus, most are Didermas. Only D. farinaceum Schrad., now generally recognized to be

the same as the earlier Physarum melanospermum Pers., would be included in Didymium as it is now defined, hence it must be the type of the genus.

We retain the division of the genus by G. Lister into the two subgenera Didymium, for which D. farinaceum is the type, and Lepidodermopsis (Höhn.) G. Lister, Mon. ed. 3. 109. 1925, based on L. leonina (Berk. & Br.) Höhn.

KEYS TO SPECIES

Peridial wall cartilaginous, brown, glossy, more or less covered with lime crystals, resembling Lepidoderma, but crystals not united into scales.

Subgenus Lepidodermopsis

Peridial wall membranous, more or less covered with lime crystals, these loosely scattered or united into a limy crust.

Subgenus Didymium

SUBGENUS LEPIDODERMOPSIS

(Höhn.) G. Lister, Mycet. ed. 3. 109. 1925.

With a single species.

D. leoninum

SUBGENUS DIDYMIUM

Lime crystals agglutinated to form a firm, often smooth, shell-like outer crust.

Key I

Lime crystals loosely scattered on surface of peridium or, if somewhat compacted, with rough surface layer readily crumbling.

Sessile to plasmodiocarpous, often

Key II

KEY I

Sporangiate, pulvinate, sessile or with a short, thick stalk; columella large, dome-like, the peridium attached to its margin.

D. vaccinum

effused; columella not large nor bearing peridium at its margin, often inconspicuous or lacking. Spores minutely warted or nearly smooth.

b С

Spores coarsely warted, the warts often arranged in a subreticulate pattern.

d

Pulvinate to thin and broadly effused; capillitium often rigid, the threads joined by prominent transverse bars; spores 9-11 μ .

D. listeri

Pulvinate to plasmodiocarpous; capillitium not notably rigid; spores $11-14 \mu$.

D. difforme D. quitense

d. Usually small, 0.1-0.6 mm in diameter; spores 9-10 µ.

D. trachysporum

KEY II

d.

Primarily sessile or plasmodiocarpous; stalks, if present, short and weak.

Large, 0.4-1 mm in diameter; spores 13-14 μ .

b

Primarily sporangiate and stalked; when associated with sessile or plasmodiocarpous fruitings, stalked sporangia usually present.

k

Capillitial threads marked by spiral bands; lime often only partly crystalline.

D. decipiens

Capillitial threads not spirally banded; lime usually entirely crystalline.

c

c.	Fru	ctification ochraceous to brown.	d			
c.		ctification gray or white casionally stained brownish by substratum).	e			
	d.	Yellowish brown to tawny; spores dark, tuberculate, often subreticulate, 12–14 μ .	D. fulvum			
	d.	Pale ochraceous to ochraceous brown; spores pale, nearly smooth, 7–8 μ .	D. ochroideum			
e.	Wit	With prominent vesicles intermixed with spores and capillitium.				
e.	Ves:	icles not present.	g			
	f.	Plasmodiocarpous, branched and anastomosing, more or less flattened laterally; columella wall-like; vesicles pale grayish brown, free from capillitium. Plasmodiocarpous, broadly effused, depressed, thin, without columella;	D. flexuosum			
		vesicles yellow, attached to capillitium.	D. serpula			
g.	thin	ite or pale gray, broadly effused, depressed, , with numerous limy trabeculae connecting base	D. sturgisii			
~		peridium; capillitium dark, often scanty or lacking. beculae lacking; capillitium usually abundant.	D. stargan h			
g.	h.	Dark gray; plasmodiocarp intricately labyrinthiform, the strands often flattened				
	h.	and fused into a nearly continuous perforated layer. White or, when lime is scanty, gray, dingy or metallic; sporangiate to	D. perforatum			
	Const	plasmodiocarpous, but never intricately labyrinthiform.	i			
i.	exte and	rangiate, sessile or on weak stalk-like insions of hypothallus, often densely aggregated covered by a common, fragile, v crust; spores dark, minutely warted, 10–14 µ.	D. crustaceum			
i.	Spo	D. crustaceum				
	rarely stalked; never densely aggregated and covered by a common limy crust.		j			
	j.	Sporangiate, sessile on a restricted base, varying to plasmodiocarpous, often more or less annulate; capillitium slightly elastic; spores not dark, minutely warted, 7.5–11 μ.	D. anellus			
	j.	Sessile on a broad base, pulvinate or often widely effused; capillitium strongly	D. Julium			
k.	C+a1	elastic; spores dark, prominently warted, 10–15 μ. ks calcareous.	D. dubium			
k.		Stalks not calcareous, sometimes				
х.	lightly sprinkled on surface with lime.					
	l.	Stalks, when present, not morphologically distinct. from branches of limy hypothallus; sporangia often densely clustered and covered by a common limy crust.				
	1.	Stalks, when present, morphologically distinct from hypothallus; sporangia, when grouped, not covered by a common limy crust.	m			
m.	Stalks ochraceous, slender, smooth, packed internally with lime; peridium floccose, breaking up into scaly flakes; spores					
		k, densely verrucose to subreticulate, 8–10 μ .	D. floccosum			
m.		lks white or pallid; peridium not breaking up into scales.	•			
	n.	Hypothallus prominent, branched, giving rise to clusters of deeply umbilicate sporangia with				

		crystals in stalk; spores spiny, subreticulate, $10-12 \mu$.	D. intermedium			
	n.	Hypothallus not producing branches; stalks usually				
		stout and fluted; sporangia often sessile or nearly so.	О .			
o.		rangial wall appearing double,				
		outer limy crust remote from inner				
		nbranous wall; stalks short, never half total				
		ght, often lacking; spores spinulose, ring one or more ridges				
		sometimes forming a very lax reticulum, $10-12 \mu$. D. karstensii				
0.		rangial wall not appearing double,				
٠.		limy coat borne on peridium; stalks				
		monly present, attaining two-thirds				
		otal height, but often	_			
	sho	rt or lacking; spores minutely warted, 8–11 μ .	D. squamulosum			
	p.	Stalks dark, opaque, often somewhat translucent about	ve. q			
	p.	Stalks pale, yellowish to				
		brownish orange, translucent throughout.	v			
q.		rangia flattened, discoid, erect, often	_			
		bilicate above; spores pale, nearly smooth, 6–7 μ.	D. clavus			
\mathbf{q} .		orangia globose or subglobose but varying				
		n prolate to oblate, or, if discoid, so deeply				
		bilicate and incurved as to appear pose; spores darker and larger, distinctly warted or sp	day. v			
			oiny. r			
	r.	Sporangia deeply umbilicate below, discoid but so strongly reflexed as to appear globose;				
		stalks opaque, more or less immersed in umbilicus.	s			
	r.	Sporangia globose or subglobose, only				
		slightly umbilicate below; stalks dark,				
		especially below, often paler and translucent above.	t			
s.	Spo	res violaceous brown, densely warted, 8–11 μ.	D. minus			
s.		res dark purplish brown,				
	stro		D. melanospermum			
	t.	Columella and peridium dark.	D. nigripes			
	t.	Columella pale, orange to white; peridium pale or co	olorless. u			
u.		orangia globose or slightly prolate, erect;	D			
		imella yellow, stalked; spores pale, minutely warted.	D. ovoideum			
u.	_	orangia globose to flattened or lobed.	v			
	v.	Sporangia usually ochraceous to fawn, sometimes white, globose to				
		saddle-shaped or lobed, usually				
		erect; columella prominent,				
		stalked, conspicuously roughened or spiny.	D. megalosporum			
	v.	Sporangia white or appearing gray				
		when lime is scanty, globose or if discoid, then				
		appearing globose, usually nodding;				
	C	columella white, not notably rough and never spiny.	w			
w.		ores dark, strongly rted, with notably clustered warts.	D verrucosporum			
w.		pres moderately dark to pale, minutely	D. verrucosporum			
-••		rted, without conspicuous clusters of warts.	х			
	x.	Stalk long, slender, three-fourths or				
		more of total height; capillitium delicate, pale.	D. iridis			
	x.	Stalk short, rarely half total				
		height, usually much less or lacking;				

capillitium coarse and, at least in part, dark.

morphologically distinct stalks; lime duplex, of stellate crystals on peridium, coarse rhomboid

y

y. Stalk golden yellow; capillitium dark, firm, forming a close-meshed, persistent, more or less globose reticulum, with many free, spiny tips.

D. aurantipes

y. Stalk pale, dull yellow; capillitium moderately dark, the threads lax, with few anastomoses, paler toward tips, where most are attached to the peridium.

D. laxifila

FIG. 332 Plate XXXVII Didymium anellus Morgan, Jour. Cinc. Soc. Nat. Hist. 16: 148. 1894. Didymium effusum var. tenue A. Lister, Jour. Bot. 35: 214. 1897.

Sporangiate on a constricted base, rarely short-stalked, varying to flat-pulvinate, annulate or plasmodiocarpous, sometimes widely expanded, crustose, pitted, white, or when lime is scanty, dingy gray to dark metallic, the sporangiate forms 0.2–0.5 mm wide; peridium membranous, colorless or purplish brown, iridescent, covered with a rather sparse layer of lime crystals, occasionally limeless; dehiscence circumscissile or by a more or less elongate split; columella none or represented by an ochraceous or brownish deposit at the base of the sporangium; capillitium abundant, of freely branching and anastomosing, slender, dark threads forming a somewhat elastic net; hypothallus thin, delicate, often scarcely apparent; spores dark brown in mass, violaceous brown by transmitted light, minutely warted, the warts sometimes clustered, (7.5–)8-10(-11) μ in diameter. Plasmodium colorless.

TYPE LOCALITY: Ohio.

HABITAT: Dead leaves; herbaceous stems and twigs, rarely on wood.

DISTRIBUTION: New York, through southern Canada to Washington, south to Maryland, New Mexico, and California; England; Ceylon; India, Philippines.

ILLUSTRATIONS: Jour. Cinc. Soc. Nat. Hist. 16: pl. 12, f. 41; Lister, Mycet. ed. 3. pl. 110, a-c; Macbr. & Martin, Myxom. pl. 8, f. 156–158. EXSICCATI: Jaap, Myxom. Exs. 132, 154.

The small, sporangiate and plasmodiocarpous fruitings arranged in a general plasmodiocarpous pattern, with many annulate plasmodiocarps and many of the pulvinate sporangia depressed in the center, mark this wide-spread but rather inconspicuous species. The capillitium is more netted than in most Didermas and is somewhat elastic. The resemblance to plasmodiocarpous fruitings of *D. squamulosum*, mentioned in the Lister and Hagelstein monographs, is not apparent in our material.

Stalked fruitings appear to be rare. Those which appear stalked are usually, on close examination, found to be small sporangia perched on plant hairs of the substratum.

Didymium aurantipes Brooks & Kowalski, Mycologia 58: 169. 1966.

Sporangiate, scattered or gregarious, stipitate or sometimes sessile, spherical to oblate, often flattened or concave above, flattened and slightly umbilicate below, sometimes confluent and then suggesting short plasmodiocarps, white or ashy, 0.5-1.5(-2.5) mm in diameter; hypothallus golden, orbiculate or continuous, sometimes with calcareous inclusions; stalk usually present, sometimes very short, weak, varying to cylindrical and then up to 1 mm in height, golden, translucent, or somewhat opaque at base, striate; peridium fragile, membranous and translucent, with yellowish spots above, thickened below, encrusted lightly above, more densely below, with stellate crystals, these often

massed, especially below, into large aggregates; columella prominent, subcylindrical to conical or hemispherical, white, usually filled with angular crystals; capillitium rigid, united into a more or less globose persistent reticulum, the filaments dark, only slightly paler at the tips where they join the peridium, 3–10 μ wide, expanded at the junctions, with occasional calcareous inclusions in the nodes; spores globose, black in mass, dark purplish brown by transmitted light, densely warted, with a paler and smoother area at one side, (10-)11-12 (-14) μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Butte Co., California.

HABITAT: Decayed leaves and plant litter.

DISTRIBUTION: Northern California.

ILLUSTRATIONS: Mycologia 58: 170. f. 1; 171, f. 2-3.

The above description is based on the original, somewhat shortened, and slightly modified by study of an ample collection, D.T.K. 2568, sent by the co-author. The most striking feature of this species is the reticulate capillitium, looking like the skeleton of a radiolarian, and beautifully illustrated in the authors' Fig. 2. That, with the golden translucent stem, makes this species distinctive and easy to recognize.

Didymium clavus (Alb. & Schw.) Rab., Deuts. Krypt.-Fl. 1: 280. 1844.

Physarum clavus Alb. & Schw., Consp. Fung. 96. 1805.

Didymium melanopus var. clavus (Alb. & Schw.) Fries, Syst. Myc. 3: 114. 1829

Didymium commutabile Berk. & Br., Jour. Linn. Soc. 14: 83. 1873.

Didymium neglectum Massee, Mon. 231. 1892. Not D. neglectum Berk. & Br. 1873.

Didymium masseeanum Sacc. & Syd., in Sacc., Syll. Fung. 14: 836. 1899.

Sporangia stalked, discoid, often umbilicate above, 0.5–1 mm in diameter, up to 1 mm tall, grayish white or dark when lime is scanty; peridium membranous, dark, more or less covered with lime crystals above, thickened, brown, and limeless on the under side; stalk tapering upward, longitudinally striate, dark brown or black, paler at top, sometimes so short as to be contained within the base, the sporangia then appearing sessile; columella represented by the thickened, dome-like base; capillitium delicate, the threads pale purple-brown or nearly colorless, sparsely branched; spores black in mass, pale violaceous brown by transmitted light, nearly smooth, 6–7 (–8) μ in diameter. Plasmodium gray or colorless.

TYPE LOCALITY: Germany.

HABITAT: Dead wood, twigs, and leaves.

DISTRIBUTION: Europe; Ceylon; in North America, Quebec to Washington, south to Florida and southern California; Costa Rica; West Indies.

ILLUSTRATIONS: Alb. & Schw., Consp. Fung. pl. 2, f. 2; Lister, Mycet. ed. 3. pl. 108.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2091; Jaap, Myxom. Exs. 70, 109, 131, 194; Hintikka, Myxogast. Fenn. 4; Brândză, Myxom. Roum. 102 (IA).

A distinctive species, in shape and size resembling *Diderma hemisphaericum*, from which it differs in its crystalline lime and smaller spores. It often fruits in small colonies, hence is easily overlooked.

FIG. 333 Plate XXXVII Didymium crustaceum Fries, Syst. Myc. 3: 124. 1829.

FIG. 334
Plate XXXVII

Didymium confluens Rost. Mon. 164. 1874 (based on Physarum confluens Pers., Syn. Fung. 169. 1801, in part).

Sporangia short-stalked or sessile, closely aggregated, globose or deformed by pressure, 0.7–2 mm in diameter, pure white; peridium double, the outer wall limy, fragile, distant, sometimes forming a continuous crust composed of large calcareous crystals over all or part of the cluster, the inner wall membranous, transparent, scantily clothed with the crystals; stalk, when present, calcareous, pale white or buff, weak, sometimes nearly obsolete; hypothallus membranous, often more or less limy, not prominent; capillitium rather rigid, sparsely branched, except at the tips, with some anastomoses, yellow-brown; spores black in mass, lilaceous brown by transmitted light, minutely warted or spinulose, 10-14(-16) μ in diameter. Plasmodium white.

TYPE LOCALITY: The Alps.

HABITAT: Dead wood, twigs and leaves.

DISTRIBUTION: Great Britain; central Europe; Japan; Hawaii; Pennsylvania and southern Canada to Washington, south to North Carolina and Colorado; South America; India.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 111; Hagelst., Mycet. N. Am. pl. 10, f. 2.

EXSICCATI: Brândză, Myxom. Roum. III. 1: 14(NY); 88(IA).

In its crowded masses of white, irregular sporangia, some approaching short plasmodiocarps, the clusters more or less covered by the rough, limy crust, this species does have a superficial resemblance to *Diderma spumarioides*. The crust is composed of crystals, however, and it is above the sporangia rather than beneath them. The hypothallus is strand-like, and the weak stalks of some of the sporangia are branches of these strands.

Fries cites as a synonym "Spumaria Physaroides Dec. Fr. 2. p. 101. fide accuratae descriptionis." The reference is evidently to DC., Fl. Fr. 5: 101. 1805, but de Candolle cites Spumaria physaroides Pers., Syn. Fung. 163. 1801, and the description there given would seem to apply better to Mucilago crustacea than to what is now called Didymium crustaceum. This raises a question about the validity of applying Fries's name. As Lister notes, the early synonymy given by Rostafinski under D. confluens is very uncertain. Rostafinski does cite Fries's name with the comment "Excl. syn." Physarum confluens Link, Ges. Nat. Freunde Berlin Mag. 7: 42. 1815, is mentioned by Fries, Syst. Myc. 3: 136. 1829, with the comment "Cfr. Ph. leucophaeum." Pending examination of European types, so far as they are still available, the name currently used should be retained.

The variety *obducens* Karst., Nat. Sällsk. Faun. Fl. Fenn. 9: 356. 1868, n.v., as described in Sacc. Syll. 7: 379. 1888, seems to fall within the limit of variation permissible to a species.

Didymium decipiens Meylan, Bull. Soc. Vaud. Sci. Nat. 58: 319. 1935.

fig. 335 Plate XXXVII Plasmodiocarps flat, thin, expanded, varying from dull gray when lime is scanty to nearly white when it is more abundant; peridium membranous, yellow-brown ("pelluciditate rufa" in orig. descr.), more or less sprinkled or encrusted with lime in the form of a few large and many small crystals, but mostly as granules; capillitium abundant, pale brownish yellow, composed of nearly straight or tortuous, sparsely branched threads about 3 μ in diameter, slightly expanded at the attached bases and at the tips, where they are mostly attached to the peridium, bearing 3–4 (1–3 in orig.) closely wound spiral

bands except at the smooth expanded ends, the threads sometimes spirally twisted about each other; spores black in mass, deep purplish brown by transmitted light, densely and strongly warted, globose or often ovate or elliptical in outline, (13-)14-16(-17) μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Ste.-Croix, Switzerland.

HABITAT: Dead plant litter near melting snow.

DISTRIBUTION: Swiss Alps.

The preceding description is based partly on the original description and partly on examination of a small fragment collected by Meylan and sent to us by Dr. T. E. Brooks. The original diagnosis included no details of the external appearance, stating only that it was indistinguishable in that respect from D. dubium. In Mycetozoa ed. 3, p. 121, G. Lister, under D. wilczekii, mentions a collection with capillitium consisting of "pale and nearly simple threads marked throughout with one to three close spiral bands." In our material there are consistently three or four such bands, many, if not all, apparently attached both to the base and the peridium of the thin, expanded fructification, smooth only near the expanded bases and tips. The bands are exactly like those of a typical Trichia and the coiling of the elaters about one another suggests that feature as it appears in Metatrichia vesparium except for the lack of free, sculptured ends. This, and the large, very dark, strongly warted spores and, if our specimen is typical, the aberrant character of the lime, are the marks of this unusual species. Genera have been erected on less distinctive grounds.

Didymium difforme (Pers.) S. F. Gray, Nat. Arr. Brit. Pl. 1: 571. 1821.

Diderma difforme Pers., Tent. Disp. Fung. 9. 1797.

Licea caesia Schum., Enum. Pl. Saell. 2: 219. 1803.

Amphisporium versicolor Link, Ges. Nat. Freunde Berlin Mag. 7: 41. 1813.

Licea alba Nees, in Kunze & Schmidt, Myk. Hefte 2: 66. 1823.

Lycogala minutum Grev., Scot. Crypt. Fl. pl. 40. 1823.

Reticularia pusilla Fries, Syst. Orbis. Veg. 147. 1825.

Physarum album (Nees) Fries, Syst. Myc. 3: 147. 1829.

Physarum caesium (Schum.) Fries, Syst. Myc. 3: 147. 1829.

Licea macrospora Schw., Trans. Am. Phil. Soc. II. 4: 258. 1832.

Diderma neesii Corda, Ic. Fung. 2: 23. 1838.

Diderma libertianum Fresen., Beitr. Mykol. 28. 1850.

Didymium libertianum (Fresen.) de Bary, Mycet. 124. 1864.

Chondrioderma difforme (Pers.) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27-28: 74. 1873.

Chondrioderma liceoides Rost., Mon. App. 17. 1876.

Diderma persoonii Macbr., N. Am. Slime-Moulds 96. 1899.

Didymium tubulatum Jahn, Ber. Deuts. Bot. Ges. 36: 663. 1919.

Sporangia sessile, gregarious, flat-pulvinate, 0.3–1 mm broad, varying to short, netted or effused plasmodiocarps up to 25 mm in length, smooth, white; peridium double, the outer wall crustose, Diderma-like, composed of densely aggregated lime crystals, sometimes lacking, the inner wall delicate, purplish or colorless, iridescent; capillitium usually scanty, sometimes profuse, of brown or nearly colorless, dichotomously branching threads, often rather coarse below, slender above; columella lacking or represented by the purplish, thickened calcareous base; spores black in mass, dark purple-brown or purplish gray by transmitted light, minutely warted or smooth, 11– $14~\mu$ in diameter; sometimes with a thicker portion forming a cap at one side. Plasmodium colorless or yellow.

FIG. 336 Plate XXXVII TYPE LOCALITY: Europe.

HABITAT: Dead leaves, herbaceous stalks, and dung of herbivorous animals. DISTRIBUTION: Widely distributed in Europe and temperate North America; reported from South America and Japan. To be expected wherever Myxomycetes are found.

ILLUSTRATIONS: Grev., Scot. Crypt. Fl. pl. 40; Lister, Mycet. ed. 3. pl. 104. EXSICCATI: Sydow, Myc. Germ. 1799; Jaap, Myxom. Exs. 11, 29, 69, 108, 174; Brândză, Myxom. Roum. 40(NY).

Under the lens or binocular, pulvinate fruitings of this species, with the smooth, crustose wall, suggest *Diderma testaceum*. The wall, however, is definitely crystalline although the crystals are densely compacted, and the spores are much larger and darker.

In the third edition of the Lister monograph, G. Lister recognizes two varieties. The var. comatum A. Lister, Jour. Bot. 39: 8. 1901, was based mainly on the abundant capillitium and also on the paler and smaller spores, but the latter difference was not characteristic of another collection. Nannenga-Bremekamp has recently raised Lister's variety to species rank as D. comatum (A. Lister) Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 69: 361. 1966, making a collection from Japan, now in the British Museum, the type, and emphasizing the abundant, fluffy capillitium, the dark brown, rather than black spore-mass, the rough base of the capillitium and the paler spores. A specimen from A. & G. Lister, distributed as D. difforme var. comatum in Japa 174, cited above, does not agree entirely with the variety, and a specimen from Nannenga-Bremekamp, No. 4519 as var. comatum and specifically marked "mixed with D. difforme," seems to intergrade completely and so do our other specimens. On the basis of present information, we are unable to consider D. comatum as sufficiently clearly established.

Leocarpus calcareous Link, Ges. Nat. Freunde Berlin Mag. 3: 26. 1809; Diderma chalybeum Weinm., Fl. Ross. 592. 1836; and Chondrioderma calcareum (Link) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27–28: 74. 1873, are cited in Lister, Mycet. ed. 3. 110. 1925, as possible synonyms of this variety.

The var. repandum G. Lister, Jour. Bot. 59: 91. 1921, = Didymium tubulatum Jahn, cited above, is described as broadly applanate, with funnel-shaped columns of lime connecting the base and peridium. We have seen no specimens. It may be worthy of recognition as a distinct species, in which case Jahn's name would take precedence over G. Lister's varietal designation.

Other suggested possible synonyms of D. difforme are Reticularia angulata Pers., in J. F. Gmel., Syst. Nat. 2: 1472. 1791; and Didymium cyanescens Fries, Symb. Gast. 19. 1818=Diderma cyanescens (Fries) Fries, Syst. Myc. 3: 109. 1829. Diderma liceoides Fries, Summa Veg. Scand. 450. 1849, may be the same as the last two.

The species appears to be uncommon in eastern North America. It may have been confused, as suggested, with *Diderma testaceum*.

Didymium dubium Rost., Mon. 152. 1874.

FIG. 337 Plate XXXVIII Didymium wilczekii Meylan, Bull. Soc. Vaud. Sci. Nat. 44: 290. 1908. Didymium nivicolum Meylan, Bull. Soc. Vaud. Sci. Nat. 57: 40. 1929.

Plasmodiocarps white or grayish white, flat, thin, 1–30 mm long, 1–6 mm wide, 0.3–0.5 mm thick, usually accompanied by small, flat-pulvinate, sporangiate fructifications; peridium membranous, firm, colorless, purplish or tawny, more or less covered with a white, often floccose crust of minute, stellate, rod-like or nodular lime crystals, but these may be compacted into a limy crust, sometimes nearly limeless and then dark, or the lime occasionally in the form of scales; columella usually represented by the thickened base; capillitium abundant, rigid, the threads brown to pallid, radiating, branching and anastomosing

freely by nearly transverse bars, thus forming an elastic net which separates readily from the base and peridium; spores black in mass, purplish brown by transmitted light, often darker on one side, distinctly and closely warted, 10–15 μ in diameter. Plasmodium gray.

TYPE LOCALITY: Hauenstein, Bohemia.

HABITAT: Dead herbaceous stalks, twigs, and leaves.

DISTRIBUTION: England; central Europe; Missouri, Kansas, Colorado, Ari-

zona, Alaska, Oregon, California; India. ILLUSTRATION: Lister, Mycet. ed. 3. pl. 194. EXSICCATI: Jaap, Myxom. Exs. 93, 110, 196.

The flat, gray plasmodiocarps, usually rather sparsely covered with lime in the form of small, densely aggregated crystals, and the rather dark, large spores are the mark of this species. Specimens occur, however, in which the peridium is distinctly crustose, especially in those referred to D. wilczekii and D. nivicolum. What is here called D. listeri appears to have been included in D. dubium by Rostafinski and his interpretation is essentially that adopted by the Lister monograph. Pl. 105 of the third edition represents, as Hagelstein pointed out, what is here treated as D. listeri. That species may be distinguished from D. dubium by its smaller, smoother spores and less elastic capillitium.

Didymium tussilaginis (Berk. & Br.) Massee, Mon. 244. 1892, based on Physarum tussilaginis Berk. & Br., Ann. Mag. Nat. Hist. IV. 17: 139. 1876, may belong here. A specimen distributed by Rab.-Wint.-Paz. as "Didymium tussilaginis Berk. & Br." in the N. Y. Botanical Garden appears to belong here. A. Lister, Mon. 99. 1894, treated both names as synonyms of D. effusum, but G. Lister in the second and third editions of the monograph made them synonyms of D. squamulosum.

The lime crystals in the capillitium, mentioned by several authors and stressed by Massee, have not been observed in our material.

Further study with adequate material may reveal that there is only a single, variable species involved, or, on the other hand, that there are three or four closely related but distinguishable species included.

Didymium flexuosum Yamashiro, Jour. Sci. Hiroshima Univ. Ser. B, 2. 3: 31. 1936.

Didymium parietale Martin & Brooks, Trans. Am. Micr. Soc. 57: 320. 1938.

Plasmodiocarps white or cinereous, laterally compressed, branching and anastomosing to form an intricate net, with occasional simple plasmodiocarps or sporangia interspersed, 0.2–0.4 mm wide, borne on a broadly expanded but colorless and inconspicuous hypothallus; peridium membranous, fragile, translucent, iridescent, sparsely to densely powdered with white lime crystals, these sometimes aggregated into small, discoid platelets, rarely limeless; columella conspicuous, wall-like, elongated, extending longitudinally nearly the full length of the plasmodiocarp, attached to the base by broad extensions, free above; capillitium dense, with few anastomoses, the threads slender, brownish and 2 μ in diameter below, hyaline and more slender at the tips; spores black in mass, interspersed with numerous vesicular bodies colored like the spores but paler, larger and more irregular in shape; spores dark brown by transmitted light, sparsely and irregularly spiny or subreticulate, (10–)11–13 μ in diameter. Plasmodium probably white.

TYPE LOCALITY: Kyushu, Japan.

HABITAT: Dead leaves.

DISTRIBUTION: Japan; Iowa, Kansas.

FIG. 339 Plate XXXVIII ILLUSTRATIONS: Jour. Sci. Hiroshima B, 2. 3: 31, f. 3; pl. 3, f. 5–7; Trans. Am. Micr. Soc. 57: 320, f. 1–5.

The distinctive features of this species are the elongated limy columella rising to about half the internal height of the plasmodiocarps, and the curious vesicular bodies interspersed with the spores. While there are minor differences between Yamashiro's description and that given above, these do not transcend the expected variation within a species and there seems little doubt that his species is conspecific with *D. parietale* Martin & Brooks, known from several collections by Dr. Brooks in Kansas and Iowa.

Yamashiro speaks of the vesicular bodies as borne on the capillitium, but that is not clear in our material. His spore size is given as $10-12~\mu$, which is not significantly different from the $11-13~\mu$ reported for D. parietale.

Didymium serpula has similar vesicular bodies interspersed with the capillitium and spores, but they are yellow, larger, and clearly connected with the capillitium, the central elongated columella is lacking and the spores are smaller, paler and minutely warted.

Didymium floccosum Martin, Thind & Rehill, Mycologia 51: 160. 1959.

FIG. 340 Plate XXXVIII Sporangia stalked, gregarious, flattened-globose, or globose, umbilicate below, 0.4–0.6 mm in diameter, up to 1.5 mm tall; peridium ashy, composed of a thin translucent membrane covered with clustered crystals, in dehiscence tending to break up into minute scales, each scale bearing clusters of crystals; columella dark, clavate, rather small, not exceeding one-half of peridial cavity; capillitium dark, delicate, not exceeding 1.5 μ in diameter, sometimes bearing nodular thickenings, flexuous, sparingly branched and anastomosing; stalk ochraceous, darker below, smooth externally but packed with densely aggregated lime granules, up to 1.2 mm in height, 0.2–0.3 mm in diameter at base, tapering to 0.1 mm above, arising from an inconspicuous rotate hypothallus; spores black in mass, dark yellow-brown under lens, globose to broadly oval, densely verrucose, the warts often clustered and arranged in an obscurely reticulate pattern, 8–10 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Dehra Dun, India.

навітат: Dead leaves.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATION: Mycologia 51: 161, f. 2.

The distinguishing marks of this species are the dark ochraceous, calcareous stalks, the floccose peridium and the characteristic spores.

Didymium fulvum Sturgis, Mycologia 9: 327. 1917.

FIG. 341 Plate XXXVIII Sporangia sessile, elongate and pulvinate, rarely subglobose, or forming small plasmodiocarps, gregarious, sometimes confluent, concave beneath, pale brownish ochraceous, 0.5–0.8 mm broad, on a concolorous, membranous, lime-encrusted hypothallus which may be contracted to form a thick, stalk-like base; peridium membranous, rugose, yellow, thickly sprinkled with large, pale yellow crystals; columella represented by the convex, thickened base; capillitium abundant, delicate, the threads branching and anastomosing, pale purple-brown, becoming almost colorless at tips, frequently with dark thickenings and occasionally with fusiform, crystalline enlargements; spores dark brown by transmitted light, coarsely tuberculate, the tubercles tending to be arranged in

curved lines forming an imperfect reticulation, paler and smoother and often papillate on one side, 12–14 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Colorado.

навітат: Dead leaves and twigs.

DISTRIBUTION: Colorado; West Pakistan.

ILLUSTRATIONS: Mycologia 9: pl. 14, f. 4–6; Lister, Mycet. ed. 3. pl. 221;

Hagelst., Mycet. N. Am. pl. 2, f. 4-6.

The recent discovery of this species in the foothills of the Himalayas in West Pakistan leads to the suspicion that it has been overlooked and that it will be found in other mountainous regions.

Didymium intermedium Schroet., in P. Henn., Hedwigia 35: 209. 1896.

Didymium excelsum A. Lister, in Jahn, Ber. Deuts. Bot. Ges. 20: 275. 1902.

Sporangia stalked, gregarious, solitary, or united in simple or compound, corymbose clusters, appearing globose or somewhat irregular or lobed, 0.4–0.7 mm in diameter, in reality discoid and deeply reflexed, white or grayish; peridium thin, membranous, fragile, translucent, densely covered with a white, powdery layer of stellate crystals; stalk white or pale yellowish to ochraceous, smooth, subulate, 1–1.3 mm long, with an opaque core of coarse, not stellate, lime crystals and a hyaline cortex; hypothallus extensive, branching, white and calcareous at the bases of the stalks, elsewhere colorless or nearly so; columella small, dome-shaped, inconspicuous, its place largely taken by the inverted sporangial base; capillitium profuse, colorless, delicate, branching and anastomosing freely; spores black in mass, dark violaceous brown by transmitted light, densely covered with long, dark spines arranged to form a partial and irregular reticulation and apparently immersed in a gelatinous surface layer, 10–12 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Brazil.

HABITAT: Dead leaves, herbaceous stems, and moss-covered logs.

DISTRIBUTION: Brazil; Jamaica; Panama; Nicaragua; Missouri; California; Japan.

ILLUSTRATIONS: Ber. Deuts. Bot. Ges. **20**; *pl.* 13, *f.* 5–10; Lister, Mycet. ed. 3. *pl.* 110, *d*–*f*; Univ. Iowa Stud. Nat. Hist. **17**: 349, *f.* 1, *a*–*f*.

This very striking species is evidently rare, as the large fruitings could scarcely be overlooked in the field. Its distinctive features are the deeply umbilicate and somewhat lobed sporangia, the tendency of the hypothallus to merge into branches forming clusters of sporangia, the stellate lime crystals on the peridium as contrasted with the larger non-stellate crystals in the interior of the stalk, the delicate capillitium, and the very dark spores with the spines apparently immersed in the outer gelatinous wall. In the Lister monograph, in the key to Didymium, the orange stalks are emphasized, although the description says "yellowish-white or buff." In all our specimens the stalks are white or at most pale ochraceous. The irregular reticulations on the spores are difficult to see under a dry objective but, as Jahn pointed out, are clearly visible under oil immersion.

Didymium iridis (Ditmar) Fries, Syst. Myc. 3: 120. 1829.

Cionium iridis Ditmar, in Sturm, Deuts. Fl. Pilze 1: 13. 1813.

Cionium xanthopus Ditmar, in Sturm, Deuts. Fl. Pilze 1: 87. 1816.

Didymium xanthopus (Ditmar) Fries, Syst. Myc. 3: 120. 1829.

FIG. 343 Plate XXXVIII

FIG. 342 Plate XXXVIII Physarum xanthopus (Ditmar) Schw., Trans. Am. Phil. Soc. II. 4: 257. 1832.

Didymium pertusum Berk., in Smith, Engl. Fl. 5(2): 313. 1836.

Didymium proximum Berk. & Curt., Grevillea 2: 52. 1873.

Didymium elegantissimum Massee, Mon. 243. 1892.

Didymium nigripes var. xanthopus (Ditmar) A. Lister, Mycet. 98. 1894.

Sporangia gregarious, stalked, globose or somewhat depressed, with a small umbilicus, white, 0.4-0.6(-0.7) mm in diameter, the total height rarely exceeding 1.5 mm; peridium thin, membranous, nearly or quite colorless, more or less densely covered with white lime crystals; stalk cylindric or somewhat attenuate upwards, usually two-thirds or more of the total height, erect, slender, striate, yellow or yellowish brown, translucent; columella white or whitish, turbinate, depressed-globose or subglobose; capillitium delicate, of colorless or pale yellow-brown, branching threads, always hyaline at the tips; spores brown in mass, pale violaceous by transmitted light, faintly warted or nearly smooth, 7–9 μ in diameter. Plasmodium yellowish or brown.

TYPE LOCALITY: Germany.

HABITAT: Dead leaves, mosses, twigs, and dead wood; occasionally on old dung of herbivores.

distribution: Cosmopolitan.

ILLUSTRATION: Lister, Mycet. ed. 3. pl. 102, e-g.

EXSICCATI: Ellis, N. Am. Fungi 412; Jaap, Myxom. Exs. 47; Brândză, Myxom. Roum. 38(NY).

Very commonly regarded as the variety xanthopus of D. nigripes. It has been grown extensively in culture and the pale columella and stalk seem constant.

In addition to the pale columella, paler capillitium and yellow, translucent stem, the spores are usually somewhat paler and the markings more delicate than in D. nigripes. Collins and Clark, Mycologia 58: 743. 1966, report that in crosses of various strains, the brown plasmodial color is dominant over the paler cream color.

Didymium karstensii Nann.-Brem., Acta Bot. Neerl. 13: 247. 1964.

Sporangia gregarious, sessile on a constricted base or very short-stipitate, white or pale yellow, subglobose or depressed, scarcely umbilicate, 0.5-0.7(-1.2)mm wide, up to 0.5 mm tall; peridium double, the outer layer crustose, white or yellowish, of densely compacted, small lime crystals, smooth or wrinkled, breaking away separately, the inner peridium remote, membranous, colorless or with brownish areolae, silvery and somewhat iridescent by reflected light; stalk, when present, short, rather slender, calcareous, white or yellowish; columella small, pulvinate, often spiny; capillitium of mostly pale or colorless threads, with frequent anastomoses, bearing dark nodules or thickened areas, attached to base and peridium; spores dark purplish brown in mass, purplish brown by transmitted light, spinulose and bearing one or more ridges which may be partly united into a lax reticulation, $10-12 \mu$ in diameter. Plasmodium unknown.

TYPE LOCALITY: Endegeest, Netherlands.

HABITAT: Dead leaves of Ilex.

DISTRIBUTION: Known only from the type locality.

ILLUSTRATIONS: Acta Bot. Neerl. 13: 248, f. 1.

This description is based on the original description and illustrations, as we have seen no specimens. The author compares it with D. squamulosum, from which it would appear to be sharply separated by the crustose outer wall, distant from the membranous inner peridium and, less sharply, by the capillitial and spore characters. Several collections are listed in the original description, all from the same area and on the same substratum, of which Karstens 387 is the type.

Didymium laxifila G. Lister & Ross, Essex Nat. 27: 263. 1943.

FIG. 364 Plate XLI

Sporangiate, stipitate, scattered or clustered, white or grayish white; sporangia appearing subglobose, more or less flattened, deeply umbilicate below and often somewhat concave above, 0.5–0.8 mm in diameter, the peridium dark, membranous, densely coated with rather large aggregations of lime crystals which are white by reflected light but slightly yellowish by transmitted light; stalk reddish brown, limeless, translucent when moist, arising from a prominent circular hypothallus, 0.5–1.2 mm long; total height up to 1.5 mm; columella large, white, hemispherical on a short stalk, enclosing crystalline lime; capillitium abundant, of coarse, tufted, branching, sparsely anastomosing, dark to pallid threads bearing numerous swellings; spores dark purplish in mass, brown by transmitted light, minutely warted, with a nearly smooth pale area, 9–11 μ in diameter. Plasmodium probably pale green.

TYPE LOCALITY: Epping Forest, Essex, England.

HABITAT: Dead leaves.

DISTRIBUTION: England; Iowa.

The preceding description has been somewhat modified from the original on the basis of two collections, one from London, contributed by B. Ing (No. 63206), and one from Iowa (GWM 6556). The Iowa specimen, collected in 1937, had been put aside as probably undescribed, but on reexamination it was referred to this species and the determination has been confirmed by Mr. Ing. An additional collection from Cheshire so labelled is regarded as doubtfully referred to this species.

In the original description, the species is said to have affinity with *D. squamulosum* and *D. crustaceum*. It differs from both in several respects, notably in the translucent limeless stem, which separates it from the former, and in the lack of the crustose covering layer as well as the stem character, from the latter. The aggregations of crystals on the peridium suggest those of *D. floccosum*, but are smaller and that species also has a calcareous stem.

Didymium leoninum Berk. & Br., Jour. Linn. Soc. 14: 83. 1873.

Lepidodermopsis leonina (Berk. & Br.) Höhnel, Sitz.-ber. Akad. Wien 118: 439. 1909 (as leoninus).

Fructification sporangiate or plasmodiocarpous; sporangia scattered or loosely clustered, stalked, subglobose, 0.6–0.7 mm in diameter, dark purplish brown and glossy, broadly veined with white or buff deposits of large, stellate lime crystals, or sometimes completely covered with lime and then uniformly pale buff or whitish; peridium cartilaginous, chestnut-brown with thinner yellow lines of dehiscence as seen by transmitted light, at length breaking into scale-like fragments; columella subglobose, orange; stalk stout, yellow, orange or brown, 0.4–0.6 mm high, often arising from a vein-like, spongy hypothallus charged with crystalline lime; plasmodiocarps flat, effused, without columellae, up to several cm across and nearly covering surfaces of leaves on which they occur; capillitium of slender, branched and anastomosing dark brown threads, pale at the extremities where they are often attached to peridium; spores

FIG. 344 Plate XXXVIII violet-gray, minutely warted, the warts sometimes arranged in lines, 7–9 μ in diameter. Plasmodium orange-red.

TYPE LOCALITY: Peradeniya, Ceylon.

HABITAT: Dead leaves.

DISTRIBUTION: Ceylon; India; Singapore; Java; Japan, Philippines.

ILLUSTRATIONS: Sitz.-ber. Akad. Wien 118: 439, f. 35; Lister, Mycet. ed. 3, pl. 113; Hattori, Myxom. Nasu, f. 3 (var. effusum); Indian Phytopathology 11: 105, f. 7, a-c.

This species was included by Rostafinski, Mon. App. 23. 1876, in Lepidoderma tigrinum, which it resembles superficially, but the large, stellate lime crystals separate it clearly. In the original description, Berkeley noted its resemblance to Didymium tigrinum. Höhnel maintained that the species fitted into neither Didymium nor Lepidoderma and on that basis made it the type of the monotypic genus Lepidodermopsis. Höhnel's arguments are convincing, but he perhaps overemphasizes the importance of the differences he cites. The cartilaginous peridium is unique in Didymium, but the color is certainly less important and the stalk is scarcely more distinctive than that of D. megalosporum. Until further information is available, it may remain in Didymium as a subgenus, comparable to Leangium in Diderma.

The plasmodiocarpous phase, known only from Japan, was described by G. Lister, Jour. Bot. 71: 220. 1933, as var. effusum. From the description, and Hattori's illustration, this is so different from the typical form that it may well prove to be a distinct species. It was found in the same locality as the typical form and is said to have arisen from a "similar" plasmodium, but the sporangiate and plasmodiocarpous forms were not associated in the same fruitings and no transitional stages are known, as is usually the case when the same species shows such variation in fruiting.

Didymium listeri Massee, Mon. 244. 1892.

FIG. 345 Plate XXXIX Sporangiate, sessile, pulvinate, varying to plasmodiocarpous, attaining a length of 12 mm or more, 0.3–0.5 mm thick, white; peridium double, the outer layer shell-like, composed of closely compacted lime-crystals, the surface coated with a powdery layer of loose crystals, the inner layer delicate, membranous, dark, adherent or remote; columella none or represented by a thickened base; capillitium profuse, the threads rigid, dark brown or rarely pallid, connected by transverse bars and joined by the pale tips to the inner peridial wall, scarcely elastic; spores blackish brown in mass, violaceous brown by transmitted light, minutely punctate, 9–11 μ in diameter. Plasmodium watery white.

TYPE LOCALITY: Lyme Regis, England.

HABITAT: Dead leaves and stems.

DISTRIBUTION: Europe; Iowa, Kansas, California; Bermuda; India; West Pakistan.

ILLUSTRATIONS: Massee, Mon. pl. 4, f. 97-101; Lister, Mycet. ed. 3. pl. 105 (as Didymium dubium).

EXSICCATUS: Jaap, Myxom. Exs. 153.

Obviously close to *D. dubium*, in which it was formerly included. In the original description, Massee emphasized the dark, rigid capillitium with the threads connected by transverse bars. This character appears to be inconstant, but the capillitium is not notably elastic as in *D. dubium*. The firm peridium, clearly composed of closely aggregated crystals, seems more distinctive. The spores also are smaller, paler and less distinctly warted than are those of *D. dubium*.

Didymium megalosporum Berk. & Curt., Grevillea 2: 53. 1873.

Didymium eximium Peck, Ann. Rep. N. Y. State Mus. 31: 41. 1879.

Didymium fulvellum Massee, Mon. 237. 1892.

Didymium nigripes var. eximium (Peck) A. Lister, Mycet. 98. 1894.

Didymium discoideum Thind & Sehg., Mycologia **56**: 566. 1964. Not D. discoideum Rost., 1876.

Sporangia gregarious, stalked, depressed-globose, discoid, usually umbilicate above and below; often subannulate or lobate, white to ochraceous or pale gray, 0.4–0.7 mm in diameter, to 1.8 mm tall; peridium membranous, often yellowish or ochraceous brown under the lime, rather sparsely clothed with yellowish or white lime crystals; stalk slender, cylindric, striate, pale yellow-brown to orange, translucent except at the base which is usually darker, seated on a prominent discoidal hypothallus; columella stalked, prominent, subglobose to discoid, dull yellow to orange-brown, rough or spiny above, capillitium arising from spines where these are present, scanty, pallid or smoky, netted; spores black in mass, violaceous brown by transmitted light, minutely warted to nearly smooth, 8–10(–12) μ in diameter. Plasmodium unknown.

TYPE LOCALITY: South Carolina.

HABITAT: Dead leaves and plant litter.

DISTRIBUTION: Maine to Ontario, south to South Carolina, Colorado, and Mexico; Europe; Africa; Asia.

ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 102, d.; Mycologia **56**: 566, f. 4, A-E.

EXSICCATI: Ellis & Ev., N. Am. Fungi 2089, 2493; Jaap, Myxom. Exs. 92.

The distinctive features of this species are its flattened, often ring-like or lobate, sporangia, the spiny or rough columella, and the usually yellowish color, although that is not constant. When spines are present on the columella, the capillitium appears to arise from these and is, at least in part, attached to the peridium.

Berkeley's original description is inconclusive. He refers to the spores as "large, brown," and the other characters mentioned could apply to various species. However, Mr. B. Ing has recently examined the type, now at Kew, and reports (in litt.) that it is undoubtedly the same as D. eximium Peck and D. discoideum Thind & Sehg. He finds the spores to be 9.2–10.1 mm in diameter, scarcely warranting the specific epithet Berkeley applied, but it was validly published.

The portion of the type of *D. discoideum* Thind & Sehg. in the Iowa collection is somewhat immature, which may account for the large range in spore size given in the original description. The capillitium, as described and as shown in the figure cited, includes the spines of the columella which merge into main branches of the capillitium.

Didymium melanospermum (Pers.) Macbr., N. Am. Slime-Moulds 88. 1899.

Physarum melanospermum Pers., Neues Mag. Bot. 1: 88. 1794. Not P. melanospermum Sturgis, 1917.

Didymium farinaceum Schrad., Nov. Gen. Pl. 22. 1797.

Trichia compressa Trent., in Roth, Catalecta Bot. 1: 229. 1797.

Trichia sphaerocephala Sow., Engl. Fungi, Pl. 240. 1799.

Spumaria physaroides Pers., Syn. Fung. 163. 1801.

Physarum farinaceum (Schrad.) Pers., Syn. Fung. 174. 1801.

Trichia farinosa (Schrad.) Poir., in Lam. Encyc. 8: 53. 1808.

Physarum sinuosum Link, Ges. Nat. Freunde Berlin Mag. 3: 27. 1809. Not P. sinuosum (Bull.) Weinm., in Fries, 1829. FIG. 346 Plate XXXIX

FIG. 338

Plate XXXVIII

Physarum capitatum Link, Ges. Nat. Freunde Berlin Mag. 3: 27. 1809.

Didymium physaroides (Pers.) Fries, Symb. Gast. 21. 1818.

Cionium farinaceum (Schrad.) S. F. Gray, Nat. Arr. Brit. Pl. 1: 571. 1821. Cionium lobatum Spreng., Syst. 4(1): 529. 1827.

Didymium lobatum (Spreng.) Schw., Trans. Am. Phil. Soc. II. 4: 257. 1832. Didymium fairmanii Sacc., in Fairman, Jour. Myc. 5: 78. 1889.

Sporangia gregarious, stalked or sessile, or somewhat plasmodiocarpous, subglobose or depressed, deeply umbilicate below, 0.5–1 mm in diameter, up to 1 mm tall, white or gray; peridium firm, dull brown, frosted with lime crystals, breaking irregularly; stalk, when present, usually short, stout, fluted, opaque, dull brown or black, often completely immersed in the umbilicate base of the sporangium, rarely varying to two-thirds of the total height, then occasionally paler above; hypothallus dark, inconspicuous; columella prominent, hemispheric, dark or pallid, calcareous; capillitium of sparingly branched, pale or brownish, sinuous threads varying from slender to robust, often bearing dark, nodular thickenings; spores black in mass, dull purplish brown by transmitted light, strongly warted or spinulose, 10–14 μ in diameter. Plasmodium colorless or dull gray.

TYPE LOCALITY: Europe.

HABITAT: Dead wood, twigs and leaves.

DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Schrad., Nov. Gen. Pl. pl. 5, f. 6; Sow. Engl. Fungi, pl. 240; Lister, Mycet. ed. 3. pl. 112, a-c.

EXSICCATI: Sydow, Myc. Germ. 1800; Ellis & Ev., N. Am. Fungi 2085 (as *Physarum cinereum*), 2689; Jaap, Myxom. Exs. 12, 71, 91.

This very common species differs from *D. nigripes* in its usually more robust fruitings, flattened and deeply umbilicate sporangia, shorter and thicker stem and greater tendency to sessile or plasmodiocarpous fruitings, and particularly in its much larger, darker and more strongly marked spores. *D. minus* also tends to have flattened sporangia with deep umbilicus, but is generally more delicate and has smaller and paler spores, thus approaching more closely to *D. nigripes*, but still seems to be distinct.

The early synonymy is greatly confused. The Lister monograph, ed. 3, lists a number of possible synonyms, but little can be gained by assigning these names to this species until more is known about them and they are here included in the list of names of uncertain application. *Didymium lobatum* Nees, Syst. Pilze Schw. 112. 1816, f. 104, is cited as a definite synonym. This is scarcely borne out by Nees's description and figure, and if Nees's name is the source of the epithets applied by Sprengel and Schweinitz as cited, then these also become doubtful synonyms.

The Lister monograph recognizes the var. minus, here treated as a distinct species, and the var. bicolor G. Lister, Mon. ed. 3. 115. 1925, with vesicles in the upper part of the stem and the columella filled with crystalline lime granules. We have seen no authentic material but such aggregations appear occasionally in this and other species and may be the result of special environmental factors during development.

FIG. 347 Plate XXXIX Didymium minus (A. Lister) Morgan, Jour. Cinc. Soc. Nat. Hist. 16: 145. 1894. Didymium farinaceum var. minus A. Lister, Mycet. 97. 1894.

Didymium melanospermum var. minus (A. Lister) G. Lister, Mycet. ed. 3. 115. 1925.

Sporangia stalked, gregarious, depressed-globose, umbilicate below, white

or pale gray, 0.4–0.6 mm in diameter, rarely exceeding 0.8 mm in total height, occasionally subplasmodiocarpous; peridium membranous, delicate, dull, frosted with lime crystals; stalk erect, rather slender, brown to blackish, faintly striate, opaque and granular, not greatly exceeding the diameter of the sporangium, usually shorter, rarely lacking; columella dark brown to sordid whitish, globose or depressed-globose, rough, attaining about the center of the sporangium; hypothallus dark, often forming disks under the sporangia; capillitium delicate, almost colorless, usually scanty, branched, radiating, with few anastomoses; spores black in mass, dark violaceous brown by transmitted light, minutely and densely warted, the warts often clustered, 8–11 μ in diameter. Plasmodium dark purplish gray.

TYPE LOCALITY: England.
HABITAT: Dead bark and litter.
DISTRIBUTION: Cosmopolitan.

ILLUSTRATION: Lister, Mycet. ed. 3. pl. 112, d-f. EXSICCATUS: Brândză, Myxom. Roum. 90(IA).

This is regarded as a variety of *D. melanospermum* by the Listers and by Hagelstein. It is true that there is an overlap in size, but the paler capillitium and stalks, and the smaller, less strongly marked spores appear to be constant. The sporangia seem to be less flattened as a rule but that could be correlated with the smaller size. Fruitings which appear sessile nearly always have short stems hidden by the umbilicate base.

The Lister monograph cites D. humile Haszl., Oesterr. Bot. Zeits. 27: 84. 1877, as a synonym of the var. minus. If this is correct, the name has priority over the combination D. minus. The sporangium is described as slightly umbilicate above and deeply umbilicate below, about one-third as thick as wide, and with spores $6-7 \mu$ in diameter. It is not certain that it belongs here.

Didymium nigripes (Link) Fries, Syst. Myc. 3: 119. 1829.

Physarum nigripes Link, Ges. Nat. Freunde Berlin Mag. 3: 27. 1809.

Physarum microcarpon Fries, Symb. Gast. 23. 1818.

Didymium microcephalum Chev., Fung. & Byss. III. f. 2. 1837.

Didymium porphyropus Dur. & Mont., in Durieu, Fl. Alger. Bot. 1: 409. 1848.

Didymium microcarpon (Fries) Rost., Mon. 157. 1874.

Didymium tenue Pat. & Gaill., Bull. Soc. Myc. Fr. 4: 96. 1888.

Sporangia gregarious, stalked, globose or hemispherical, somewhat umbilicate beneath, 0.3–0.5(–0.7) mm in diameter, the total height up to 1.5(–2) mm; peridium membranous, smoky, covered with white calcareous crystals; columella dark brown, subglobose, calcareous within; stalk slender, erect, dark brown or blackish, often filled with dark amorphous matter below, the upper portion paler, translucent; hypothallus discoid, black; capillitium delicate, the threads brown or colorless, bearing occasional thickenings, sparingly branched and with few anastomoses; spores dark in mass, pale violaceous brown by transmitted light, minutely warted, the warts often clustered, 7–10 μ in diameter. Plasmodium gray or colorless.

TYPE LOCALITY: Germany.

HABITAT: Dead leaves, herbaceous stems, and twigs, less commonly on

wood.

distribution: Cosmopolitan.

FIG. 348
Plate XXXIX

ILLUSTRATION: Lister, Mycet. ed. 3. pl. 102, a-c.

EXSICCATI: Ellis, N. Am. Fungi 1393; Jaap, Myxom. Exs. 46, 176; Brândză, Myxom. Roum. 37(NY).

In the third edition of the Lister monograph the varieties eximium A. Lister and xanthopus A. Lister are recognized and have been widely used. In Hagelstein's monograph, as in most other recent treatments, these are treated as distinct species, the former as D. eximium, D. megalosporum of the present treatment, the latter as D. xanthopus or, in accordance with the current code, as D. iridis.

The three species are very close, but *D. megalosporum* now seems clearly distinct. *D. nigripes* and *D. iridis* have been widely used in cultural studies and while the evidence is not conclusive, the results may be regarded as tending to confirm their specific identity.

D. eunigripes, used by von Stosch to distinguish the typical form of D. nigripes from the var. xanthopus, has found its way into literature, but has no nomenclatural validity.

FIG. 349 Plate XXXIX

Didymium ochroideum G. Lister, Jour. Bot. 69: 297. 1931.

Sporangia sessile and pulvinate or forming slender plasmodiocarps, 0.2–0.5 mm broad, often depressed in the center, pale brown or ochraceous; peridium membranous, pale dull orange-brown, thickly clothed with pale yellow stellate crystals, sometimes divided into small areoles, each with a dark, raised center to which the crystals adhere; hypothallus scanty, yellowish red; columella orange, composed of the thickened and convex, somewhat limy base; capillitium a loose network of slender, yellow-brown threads; spores dark brown in mass, pale purplish gray by transmitted light, globose, minutely punctate, 6–7(–8) μ in diameter, or elliptical and correspondingly longer and narrower. Plasmodium white.

TYPE LOCALITY: Tokyo, Japan.

HABITAT: Dead leaves and herbaceous stems, mosses, and dung of herbivorous animals.

DISTRIBUTION: Japan; India; Ontario, New York, Iowa.

ILLUSTRATION: Jour. Bot. 69: pl. 598, f. 1, a-d.

This extremely inconspicuous species is rarely collected. It is distinguished by its dingy color, almost that of the leaves or dung on which it occurs, by its small size, its very small and nearly smooth spores and its pale but distinctly yellow lime crystals. Of our eleven specimens, all scanty, eight are from Iowa, suggesting that the species is less uncommon than the published records imply.

FIG. 350 Plate XXXIX Didymium ovoideum Nann.-Brem., Med. Bot. Mus. Herb. Utrecht 150: 780. 1958.

Sporangia gregarious, stipitate, 1–1.5 mm in total height, the body usually prolate, 0.4–0.5 mm in diameter, and 0.8–1 mm high, varying to globose, umbilicate at the base, sprinkled with white clusters of lime crystals; stalks redbrown, translucent, darker towards the base from the presence of included granules, springing from a small circular hypothallus, which itself is light brown with enclosed dark granules, penetrating the sporangium as the columella; peridium colorless, thin and translucent, but at first covered with a white dust formed by the clusters of lime crystals, afterwards, when the crystals are rubbed off, appearing olive-brown due to the presence of the spores, frail and

irregularly dehiscent; columella stalked, usually yellow, sometimes whitish and capped with lime crystals, prolate or globose to discoid, rugose; capillitium profuse, consisting of thin, yellowish brown, branching and anastomosing threads bearing dark swellings, paler toward the tips; spores globose, $(7-)8-9(-10)~\mu$ in diameter, dark brown in mass, pale violaceous brown by transmitted light, irregularly and minutely warted, the warts usually in curved rows. Plasmodium yellow.

TYPE LOCALITY: Bilthoven, Holland.

HABITAT: On dead leaves and herbaceous stems.

DISTRIBUTION: Holland; Texas.

ILLUSTRATION: Med. Bot. Mus. Herb. Utrecht 150: 780, f. 1.

This species is close to *D. iridis*, from which it differs in the usually prolate shape, the more fragile and brownish peridium, the clavate columella borne in the center of the sporangial cavity on an extension of the stalk and the yellow plasmodium. It has been collected several times in two different provinces of the Netherlands, and again in Texas.

In the original description, the diameter of the spores is given as 6–7.5 μ . Our measurements of those of the type make them somewhat larger, the majority 8–9 μ , as are those of the Texas collection.

Didymium perforatum Yamashiro, Jour. Sci. Hiroshima Univ. B2. 3: 33. 1936.

Didymium labyrinthiforme Martin, Lodhi & Khan, Sydowia 14: 283. 1961.

Plasmodiocarp cinereous, about Gull Gray of Ridgway, closely reticulate, appearing labyrinthiform, the individual veins about 0.2 mm in width, the whole up to 2 cm or more in extent; peridium delicate, membranous, smokyhyaline, iridescent, closely sprinkled with pale yellow lime crystals; columella lacking; capillitium dark, netted, the threads 1.5–2 μ thick with occasional nodose swellings, the meshes mostly 5–15 μ wide; spores globose or subglobose, blackish brown in mass, violaceous brown by transmitted light, covered with large but rather sparsely and irregularly distributed spines (9–)10–11(–12) μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Kyushu, Japan.

HABITAT: Dead leaves.

DISTRIBUTION: Japan; West Pakistan; Kansas.

ILLUSTRATIONS: Jour. Sci. Hiroshima Univ. B2, 3: 33, fig. 4; pl. 3, f. 9, 10, 11; Sydowia 14: 282, f. 1; 283, f. 2.

The densely netted plasmodiocarp suggests *D. flexuosum*, but there is no evidence of the characteristic columella and vesicular bodies of that species, the spores are smaller, the crystals are yellow and the closely netted capillitium is quite distinct.

Yamashiro's description and illustrations fit perfectly the type of *D. labyrinthi*forme. Dr. T. E. Brooks has found several excellent specimens in Kansas.

Didymium quitense (Pat.) Torrend, Broteria 7: 90. 1908.

Chondrioderma quitense Pat., in Pat. & Lagerh., Bull. Soc. Myc. Fr. 11: 212. 1895.

Fructification in the form of pulvinate, depressed sporangia 0.4–1 mm in diameter, the base rarely narrowed and stem-like, varying to short plasmodiocarps up to 5 mm long, gregarious or scattered, white; peridium double, the

FIG. 351 Plate XXXIX

> FIG. 352 Plate XL

outer layer slightly roughened, composed of small, closely compacted lime-crystals, remote from the thin, membranous, bluish, iridescent inner wall; capillitium rather sparse, the threads yellow-brown, of nearly uniform size and diameter, branching and anastomosing profusely and forming a net; spores black in mass, very dark purplish brown by transmitted light, strongly warted, the warts more or less united to form an imperfect or sometimes a rather pronounced reticulate pattern, (12-)13-14(-15) μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Ecuador.

HABITAT: Herbaceous stems and leaves and dead wood.

DISTRIBUTION: Ecuador; Canary Islands; Montana, Colorado, Oregon, California.

ILLUSTRATION: Lister, Mycet. ed. 3. pl. 218, f-h.

Patouillard, in the original description, compared this with Chondrioderma difforme, making the verrucose spores the important distinctive character. Our material from the mountains of the western United States differs from that species in the less crustose outer peridium and the more netted capillitium, the spores are somewhat larger and much darker, and there is a tendency for the warts to occur in lines forming a subreticulate pattern.

Didymium serpula Fries, Syst. Myc. 3: 126. 1829.

Lycoperdon complanatum Batsch, Elench. Fung. Contin. 1: 251. 1786.

Didymium complanatum (Batsch) Rost., Mon. 151. 1874. Not D. complanatum Schrad., 1797.

Plasmodiocarps depressed, scattered or solitary, effused, perforated or nearly continuous, dark gray, whitish, or iridescent, 0.1–0.15 mm thick, usually 2–8 mm in extent but sometimes much greater, to 4 cm; peridium membranous, dark gray or iridescent, sparsely or sometimes rather densely covered with white, stellate or irregular lime crystals; hypothallus inconspicuous; columella lacking; capillitium moderately dense, the threads slender, yellow-brown, paler and coarser where connected with the numerous subglobose vesicles 30–50 μ in diameter, filled with yellow, granular material; spores dull brown in mass, pale violaceous brown by transmitted light, minutely warted, 8–11 μ . Plasmodium yellow.

TYPE LOCALITY: Sweden.

HABITAT: Dead leaves and herbaceous stems.

DISTRIBUTION: Europe; Maine to Florida, west to Tennessee and Iowa; West Pakistan.

ILLUSTRATIONS: Batsch, Elench. Fung., pl. 29, f. 170 a-c; de Bary, Mycet. pl. 2, f. 15; Rost., Mon. pl. 9, f. 166, 180; Lister, Mycet. ed. 3. pl. 107; Macbr. & Mart., Myxom. pl. 7, f. 151-153.

EXSICCATI: Jaap, Myxom. Exs. 175, 193; Brândză, Myxom. Roum. I. 1: 13(NY); 89(IA).

The very flat plasmodiocarps, white when lime is abundant, dull gray or iridescent where it is scanty or has fallen away, and the curious yellow vesicular bodies, clearly attached to the capillitium, are the distinctive marks of this rather rare species.

In the second and third editions of the Mycetozoa, G. Lister uses the name D. complanatum for this species despite the fact that the specific epithet had been

FIG. 353 Plate XL applied previously to a different species. She lists Fries's name as a doubtful synonym but there is no other published name which can be used and Fries's description may well apply, even though Fries regarded L. complanatum Batsch as a synonym of one of the two varieties of D. cinereum (Batsch) Fries, Syst. Myc. 3: 126. 1829, which is now regarded as a synonym of Physarum cinereum. Batsch's pl. 29, f. 170 a-c could well be cited as, for the time, a fairly good representation of the present species.

Didymium squamulosum (Alb. & Schw.) Fries, Symb. Gast. 19. 1818.

Diderma squamulosum Alb. & Schw., Consp. Fung. 88. 1805.

Licea stipitata DC., Fl. Fr. 5: 101. 1815.

Didymium effusum Link, Ges. Nat. Freunde Berlin Mag. 7: 42. 1815.

Tubulina pedicellata Poir., in Lam. Encyc. Suppl. 5: 373. 1817.

Cionium squamulosum (Alb. & Schw.) Spreng., Syst. 4(1): 528. 1827.

Didymium costatum Fries, Syst. Myc. 3: 118. 1829.

Didymium herbarum Fries, Syst. Myc. 3: 120. 1829.

Physarum liceoides Duby, Bot. Gall. 861. 1830.

Didymium praecox de Bary, in Rab., Fungi Eur. 367. 1861.

Didymium radiatum Berk. & Curt., in Berk., Jour. Linn. Soc. 10: 348. 1868.

Didymium neglectum Berk. & Br., Jour. Linn. Soc. 14: 83. 1873.

Didymium fuckelianum Rost., ex Fuckel, Jahrb. Nass. Ver. Nat. 27–28: 73. 1873.

Didymium macrospermum Rost., Mon. 161. 1874.

Didymium discoideum Rost., Mon. 162. 1874.

Chondrioderma cookei Rost., Mon. App. 17. 1876.

Didymium angulatum Peck, Ann. Rep. N. Y. State Mus. 31: 41. 1879.

Didymium cookei (Rost.) Raunk., Bot. Tidssk. 17: 86. 1888.

Didymium affine Raunk., Bot. Tidssk. 17: 88. 1888.

Didymium bonianum Pat., Jour. de Bot. 5: 316. 1891.

Didymium annulatum Macbr., N. Am. Slime-Moulds, ed. 2. 125. 1922.

Usually sporangiate and stalked, but varying to sessile and plasmodiocarpous, often in the same fruiting, white, gray, or rarely pinkish when fresh, soon fading; sporangia appearing globose or depressed, in reality usually discoid and deeply umbilicate below, 0.3-1 mm in diameter, up to 1.5 mm in total height; peridium membranous, transparent, somewhat iridescent, usually covered with a thick, white crust of stellate lime crystals which often form a reticulate surface, the lime sometimes scanty; stalk stout, calcareous, usually more or less fluted but sometimes nearly smooth, white or ochraceous to orange or pinkish, arising from a discoid, concolorous hypothallus, often attaining twothirds of total height, but sometimes very short and buried in the umbilicus, or lacking; columella white or pale, discoid or hemispheric, consisting of the thickened, umbilicate sporangial base, with an expanded, subglobose or flattened tip; capillitium variable, the threads slender or coarse, nearly simple or branching profusely, colorless or pallid, less commonly dark, often bearing conspicuous thickenings; spores black in mass, dark violaceous brown by transmitted light, minutely warted or spinulose, the warts sometimes clustered, 8-11 μ in diameter. Plasmodium colorless, white, or yellow.

TYPE LOCALITY: Germany.

HABITAT: Dead plant remains of all sorts and on dung of herbivorous animals.

FIG. 354 Plate XL DISTRIBUTION: Cosmopolitan.

ILLUSTRATIONS: Alb. & Schw., Consp. Fung. pl. 4, f. 5; Rost., Mon. pl. 8, f. 134, 139–141, 148; Macbr. & Martin, Myxom. pl. 8, f. 159–163; Lister, Mycet. ed. 3. pl. 109.

EXSICCATI: Ellis, N. Am. Fungi 1216; Ellis & Ev., N. Am. Fungi 2090; Jaap, Myxom. Exs. 72, 177, 195; Brândză, Myxom. Roum. I. 1: 14; 39(NY); 101(IA).

Like other widely distributed and variable species, this has received many names, all of which appear to have been based on variations merging indistinguishably into each other. Rostafinski (Mon. 160. 1874) recognized two varieties, the var. leucopus (Fr.) Rost. and the var. costatum (Fr.) Rost. The var. claviforme Sturgis, Colo. Coll. Pub. Sci. 12: 27. 1907, was recognized by G. Lister, Mycet. ed. 3. 118. 1925, but not by Hagelstein, Mycet. N. A. 128. 1944. Both the Lister and Hagelstein monographs emphasize the frequent occurrence of plasmodiocarpous fruitings. These do occur commonly, but in practically every such development, there are some stalked sporangia or clear evidence that the plasmodiocarps have been formed by the fusion of developing sporangia. Where no such evidence is found, all the specimens so labelled which we have examined have been clearly referable to other species. Some truly sessile fruitings occur, but most fruitings which appear sessile have short stems which are buried in the basal umbilicus.

Didymium sturgisii Hagelst., Mycologia 29: 397. 1927.

Didymium anomalum Sturgis, Colo. Coll. Pub. Sci. 12: 444. 1913. Not D. anomalum (Rost.) Massee, 1892.

Plasmodiocarps white or gray, scattered or gregarious, very thin, rounded or irregular in outline, 1–10 mm in length, 0.1–0.2 mm thick; peridium membranous, white or yellowish, sprinkled, usually scantily, with white, angular or stellate lime crystals; columella none, but the thickened base giving rise to numerous, erect pillars 7–22 μ thick, enclosing white lime crystals and penetrating the plasmodiocarp to the upper surface, to which they are attached; capillitium scanty, often lacking, when present, composed of slender, dark, undulating, branched and anastomosing threads attached to the base and peridium; spores black in mass, bright violet-brown by transmitted light, minutely and irregularly warted, 10–12 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Colorado.

HABITAT: Dead wood and bark.

DISTRIBUTION: New York to Pennsylvania, west to Montana and Colorado, rare; England.

ILLUSTRATIONS: Colo. Coll. Pub. Sci. 12, pl. 2, f. 6–8; Lister, Mycet. ed. 3. pl. 213; Hagelst., Mycet. N. Am. pl. 10, f. 1.

This distinctive species is chiefly characterized by the numerous limy pillars which reach from the base to the upper peridium. They, and the capillitium, when it is present, break away from the base and tend to remain attached to the upper peridium. In the original description, Sturgis referred to the limy columns as the capillitium. This was accepted by Macbride (1922), G. Lister (1925), and Macbride and Martin (1934). Hagelstein (1944) seems to have been the first to describe the capillitial threads, but regarded the limy columns as swollen parts of the capillitial threads. Martin (1949) discarded this theory and said "capillitium none," since a mount of our scanty fragment of Sturgis's type showed no trace of the threads. Dr. Travis E. Brooks has collected the species in Kansas and a slide

FIG. 355 Plate XL received from him shows fragments of the upper peridium with both the limy trabeculae and the capillitial threads attached, but there is not the slightest suggestion that the trabeculae are part of the capillitial system.

Didymium anomalum (Rost.) Massee, Mon. 245. 1892, based on Chondrioderma anomalum Rost., Mon. 169. 1874, is cited by G. Lister as a possible synonym of D. squamulosum, but that is more than doubtful.

Didymium trachysporum G. Lister, Essex Nat. 20: 113. 1923.

Fructification sporangiate, sessile, hemispheric or pulvinate on a constricted base, scattered, 0.1–0.6 mm in diameter, or forming slender, curved, simple, branched or annulate plasmodiocarps, white or cream colored; peridium double, the outer layer a smooth or wrinkled crust of closely compacted lime-crystals, the inner layer membranous, colorless, somewhat iridescent; columella rudimentary or lacking, replaced by the pale yellow sporangial base, which is thickened at the margin and bears scanty or rarely abundant deposits of lime crystals; capillitium rather scanty, variable, consisting usually of a network of colorless or purplish, stout or slender threads, sometimes bearing vesicular expansions which enclose lime-crystals; spores black in mass, dark purplish brown by transmitted light, strongly, coarsely and irregularly warted, the warts often arranged in lines to form an imperfect reticulation, 9–10 μ in diameter. Plasmodium colorless.

TYPE LOCALITY: England.

HABITAT: Dead leaves, herbaceous stalks, decayed wood and dung of herbivorous animals.

DISTRIBUTION: Great Britain, France, Germany, Austria; Texas, Oregon.

ILLUSTRATION: Lister, Mycet. ed. 3. pl. 218, a-e.

The sporangia of our two American collections, the one from Texas isolated from air-borne spores, are rather small, and suggest that the species may be less uncommon than has been supposed. According to Lister, it is not uncommon in western Europe.

Didymium vaccinum (Dur. & Mont.) Buchet, in Buch., Cherm. & Evrard, Bull. Soc. Myc. Fr. 36: 110. 1920.

Diderma vaccinum Dur. & Mont., in Durieu, Expl. Sci. Alger. Bot. 1: 407. 1848.

Chondrioderma vaccinum (Dur. & Mont.) Rost., Mon. 180. 1874.

Didymium trochus A. Lister, Jour. Bot. 36: 164. 1898.

Sporangia scattered or clustered, short-stalked or sessile, then often elongated, hemispheric or turbinate, but rarely plasmodiocarpous, 0.6–1 mm in diameter, white to pale ochraceous; peridium double, the outer layer shell-like, smooth, composed of closely compacted lime-crystals, the inner layer membranous, yellowish brown, the two layers adherent and attached to the margin of the very large, hemispheric, ochraceous columella from which it may be detached as a whole; stalk, when present, short, stout, calcareous, furrowed, often little more than a restricted base; capillitium rigid, arising in brush-like fashion from the columella, the threads sparsely branched, colorless or pale yellowish brown, sometimes bearing vesicular enlargements which may contain lime crystals; spores black in mass, dark brown by transmitted light, prominently but sparsely warted, $(7.5-)9-12~\mu$ in diameter. Plasmodium bright yellow.

FIG. 356 Plate XL

FIG. 357 Plate XL TYPE LOCALITY: Algeria.

HABITAT: Decaying leaves and straw and desert succulents.

DISTRIBUTION: Algeria; Great Britain, Germany, Portugal; Japan; Michigan,

Missouri, California; Uruguay.

ILLUSTRATIONS: Jour. Bot. 36, pl. 386, f. 1, a-e; Lister, Mycet. ed. 3. pl. 106.

EXSICCATI: Jaap, Myxom. Exs. 192.

This species has the appearance of a *Diderma* and it is not surprising that it was originally assigned to that genus. Only the very abundant and clearly marked crystalline masses of the peridium and other limy parts place it in *Didymium*. The very large dome-shaped columella leaves relatively small space between it and the peridium for spores and they appear to fall away very rapidly after the peridium is shed. All of our specimens are old and shattered, or moldy. The best one, chosen for illustration, was collected by Macbride in California on decaying remains of a cactus. It has extremely small spores, 7.5–8 μ in diameter, but is in other respects characteristic.

Didymium verrucosporum Welden, Mycologia 46: 98. 1954.

FIG. 358 Plate XL Sporangia stipitate, globose or oblate, umbilicate below, nodding, white, (0.2-)0.3-0.4(-0.6) mm in diameter, 0.8-1.8 mm tall; peridium membranous, colorless, covered with scattered white stellate lime crystals; stalk limeless, dark brown at base, tapering upwards and somewhat paler toward apex, translucent orange-brown by transmitted light; hypothallus membranous, dark brown, inconspicuous; capillitium yellow-brown, branching, but with few anastomoses and bearing dark swellings, the tips pale; columella globose, white, about one-half the height of the sporangium; spores dark purple in mass, violaceous brown by transmitted light, coarsely and distinctly warted, the warts often in prominent groups and sometimes forming ridges, 8-9 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Rio Sardinilla, Canal Zone, Panama.

HABITAT: On dead leaves.

DISTRIBUTION: Known only from the type collection.

ILLUSTRATION: Mycologia 46: 94, f. 4, 5.

This species is obviously a member of the *Didymium nigripes* complex. It differs from that species in its pure white columella and delicate, colorless peridium, and from *D. iridis* in its darker stem and capillitium, and from both in its more prominently warted and often ridged spores.

In the original description, the diameter of the peridium is given as 0.9-1 mm. The figures given above are based on the portion of the type in the IA collection.

EXCLUDED AND DOUBTFUL SPECIES

Didymium australe Berk., in Hooker, Fl. N. Z., Fungi 2(2): 191. 1855.

Not D. australis Massee 1888. Cited by Berlese, in Sacc., Syll. 7: 378, as synonym of D. squamulosum, and again, p. 384, as uncertain, but possibly D. farinaceum Schrad.

"Didymium botryoides Berk., in Herb."

Cited by Massee, Mon. 229. 1892, as synonym of *Diderma radiatum*. Not validly published.

"Didymium capitatum Link, Diss. III. 27."

Cited by Berlese, in Sacc., Syll. 7: 381, as synonym of *D. farinaceum* Schrad. There is no Link "Diss. III." We have no record of such a name in Diss. II, but the volume is not accessible. Perhaps based on *Physarum capitatum* Link, in Diss. I, p. 27, q.v.

- "Didymium columbinum Berk. ms."
 - Cited by Rost., Mon. App. 13. 1876, as basionym of *Tilmadoche columbina* Rost. Not validly published.
- "Didymium complanatum Fuckel," Jahrb. Nass. Ver. Nat. 23-24: 341. 1870.

Cited by Rost., Mon. 183. 1874, as synonym of *Chondrioderma radiatum*. Not validly published. Fuckel cited Fries as author.

Didymium complanatum Schrad., Nov. Pl. Gen. 24. 1797. Not D. complanatum (Batsch) Rost., Mon. 151. 1874.

Cited by Rost., Mon. 164. 1874, as a synonym of *D. confluens* Rost., q.v. Transferred by Persoon, Syn. Fung. 168. 1801, to *Diderma* as *D. complanatum* (Schrad.) Pers. Berlese, in Sacc., Syll. 7: 378. 1888, cited it as a synonym of *Didymium crustaceum*; G. Lister, Mon. ed. 2. 129, as a doubtful synonym of *D. melanospermum*. Schrader's description and *pl.* 5, f. 5, suggest a *Diderma*.

Didymium contextum var. "conglomeratum" Fries, Symb. Gast. 20. 1818.

Cited by Berlese, in Sacc., Syll. 7: 342, in error for var. glomerulosum.

"Didymium costatum Fuckel," Jahrb. Nass. Ver. Nat. 25-26: 339. 1872.

Cited by Rost., Mon. 161. 1874, as synonym of *D. macrospermum* Rost. Not validly published; Fuckel names Fries as author.

Didymium daedalium Berk. & Br., Ann. Mag. Nat. Hist. II. 3: 336. 1850. Identity uncertain. See Massee, Mon. 250. 1892.

"Didymium dealbatum Berk. ms."

Cited by Rost., Mon. App. 16. 1876, as synonym of Chondrioderma sub-dictyospermum Rost. Not validly published.

Didymium farinaceum Purt., Midl. Fl. 1: 273. 1817, n.v.

Cited by Berlese, in Sacc., Syll. 7: 338, as synonym of *Physarum didermoides*. Purton may have cited Schrader's name; if not, it is a later homonym.

Didymium filamentosum Wallr., Fl. Crypt. Germ. 2: 368. 1833.

Cited by Rost., Mon. 159, 1874, as synonym, "p.p." of Didymium squamulosum. Doubtful.

"Didymium fulvipes Fries," Symb. Gast. 24. 1818.

Cited in Lister, Mycet. ed. 3. 34. 1925, as doubtful synonym of *Physarum psittacinum*. An error for *Physarum fulvipes* Fries. See following note.

Didymium fulvipes (Fries) Fries, Stirp. Femsj. 83. 1826, n.v.

The description by Fries in Syst. Myc. 3: 122. 1829, cites both the 1818 and 1826 publications but does not mention *Physarum*. The implication is that Fries transferred it from *Physarum* to *Didymium* in 1826. Lister, Mycet. 102. 1894, says "suggests a mouldy specimen, possibly of *Trichia botrytis*."

Didymium globosum var. stipitatum Swartz, Sv. Vet.-Akad. Handl. 36: 114. 1815. Cited by Berlese, in Sacc., Syll. 377, as a synonym of D. squamulosum.

"Didymium hemisphaericum Wallr.," Fl. Crypt. Germ. 2: 369. 1833.

Cited by Berlese, in Sacc., Syll. 7: 377, as a synonym of D. squamulosum. Not published as new. Wallroth published this as D. hemisphaericum Fries.

Didymium hypnophilum Massee, Jour. Roy. Micr. Soc. 1889: 757. 1889.

Cited by Massee, Mon. 224. 1892, as synonym of D. squamulosum.

Didymium leptotrichum (Racib.) Massee, Mon. 243. 1892.

Based on Chondrioderma leptotrichum Racib., Rozpr. Akad. Umiej. 12: 75. 1884. A. Lister, Mycet. 88. 1894, suggested that this may be a plasmodio-carpous form of Didymium squamulosum.

Didymium lobatum var. stipitatum Somm., Suppl. Fl. Lapp. 210. 1826, n.v.

Cited by Berlese, in Sacc., Syll. 382, as synonym of *Didymium microcarpum* (Fr.) Rost.

Didymium melanopus (Fries) Fries, Syst. Myc. 3: 114. 1829.

Based on Physarum melanopus Fries, 1818, q.v.

Didymium melanopus Wallr., Fl. Crypt. Germ. 2: 367. 1833.

Cited by Rost., Mon. 102. 1874, as in part a synonym of *Physarum cinereum*. A later homonym of *D. melanopus* (Fries) Fries, 1829.

Didymium nigrum Krzem., Acta. Soc. Bot. Polon. 29: 169. 1960.

Peridium membranous, nearly limeless; capillitium lacking; columella stuffed

with crystalline lime; spores dark, very spiny, $14-15~\mu$. Based on dark, mostly sessile, sporangia developed in profusion on sterilized rabbit dung inoculated with forest litter. On basis of description, quite unique, but possibly not a *Didymium* nor a member of any other recognized genus.

"Didymium obrusseum Sacc.," in Berlese, Sacc. Syll. 7: 346. 1888.

Cited in Massee, Mon. 247. 1892, as a synonym, in part, of *D. tenerrimum* Berk. & Curt., q.v. Berlese, in the reference cited, wrote *D. obrusseum* (Berk. & Curt.) Rost.

Didymium ossicola Pat. & Gaill., Bull. Soc. Myc. Fr. 4: 95. 1888. Doubtful. Lister, Mycet. ed. 3. 259. 1925.

Didymium parietinum Schrad., Nov. Gen. Pl. 12. 1797.

An ascomycete, Orbicula parietina (Schrad. ex Fries) Hughes. See Hughes, 1951.

Didymium platypus (Bisch.) Hazsl., Oesterr. Bot. Zeits. 27: 83. 1877.

Based on Agaricus platypus Bisch., "Bot. Taf. VII. f. 166" n.v. Cited in Lister, Mycet. ed. 3. 118. 1925, as possible synonym of Didymium squamulosum.

Didymium plicatum Corda, Ic. Fung. 3: 17. 1839.

Corda's Pl. 3, f. 47 suggests an imperfect fungus.

"Didymium polycephalum Rav."

Cited by Rost., Mon. 107. 1874, with an incomplete reference obviously to Grevillea 2: 53. 1873, as a synonym of *Physarum polymorphum* (Mont.) Rost. Probably not validly published.

Didymium pruinosum Berk. & Curt., Jour. Linn. Soc. 10: 348. 1868.

Cited by Massee, Mon. 288. 1892, as a synonym of Physarum leucophaeum.

"Didymium radiatum Massee," Mon. 229. 1892.

Cited in Lister monograph as in part a synonym of *D. clavus*. Not validly published. Massee attributed his name to Berk. & Curt.

Didymium? ramosum Duby, Bot. Gall. 2: 859. 1830.

Duby suggests it may be *Diderma ramosum* Pers. Probably not valid under Art. 34. G. Lister, Mycet. ed. 3. 259. 1825, says probably a fungus.

Didymium sinuosum Dur. & Mont., Expl. Sci. Alger. Bot. 411. 1848.

Cited by Rost., Mon. 112. 1874, probably correctly, as a synonym of *Physarum sinuosum* (Bull.) Weinm.

Didymium sowerbyi Berk., in Smith, Engl. Fungi 5(2): 213. 1836.

Based on Sowerby's Pl. 412, f. 3 of a Trichia, and the accompanying text, which tells very little. The brief diagnosis in Sacc., Syll. 7: 385 adds nothing. The name, however, is probably valid.

"Didymium squamulosum Fuckel," Jahrb. Nass. Ver. Nat. 23-24: 341. 1870.

Cited by Berlese, in Sacc., Syll. 7: 380. 1888. Not so published; Fuckel cited authors as (Alb. & Schw.) Fries. A misidentification, corrected by Rostafinski in Fuckel, Jahrb. Nass. Ver. Nat. 27–28: 73. 1874, to *D. fuckelianum* Rost., now again regarded as included in *D. squamulosum*.

Didymium trichodes Link, Ges. Nat. Freunde Berlin Mag. 7: 42. 1815.

According to Berlese, in Sacc., Syll. 7: 386, a discomycete.

Didymium versipelle Fries, Syst. Myc. 3: 117. 1829.

Possibly Lepidoderma tigrinum according to Lister, Mycet. 102. 1894.

Didymium wallrothii Rab., Fl. Crypt. Germ. 2289. 1844.

Cited by Rost., Mon. 157. 1874, as synonym of *Didymium microcarpon* (Fries) Rost., "p.p." in index.

Didymium weinmanni Fries, Syst. Myc. 3: 120. 1829.

Application regarded as uncertain from Rostafinski to present time.

Strongylium minus Fries, Symb. Gast. 9. 1817.

Cited by Rost., Mon. 155. 1874, as synonym of *D. farinaceum* Schrad. Berlese, in Sacc., Syll. 7: 381. 1888, repeats citation, but writes "S. minor Fries." Application doubtful.

Lepidoderma

de Bary, in Rost., Versuch 13. 1873.

?Lepidodermopsis Wilcz. & Meylan, Bull. Soc. Vaud. Sci. Nat. 58: 179. 1934. Not Lepidodermopsis Höhn. 1909.

Sporangiate or plasmodiocarpous. Peridium cartilaginous or membranous, covered with crystalline scales, these usually conspicuous but sometimes united into a nearly or quite continuous crust forming a distinct outer wall, sometimes composed of rather loosely compacted crystals. Capillitium as in *Didymium*, typically limeless or in one species with large and expanded nodes which are often vesicular and may enclose clusters of lime crystals.

Type species, Didymium tigrinum Schrad.

Closely related to *Didymium*, of which it might well be regarded as a subgenus. The distinctive character is in the characteristic platelets of crystalline lime. In most collections, these are very striking, but that is not always the case. The variation to nearly continuous crusts of lime, on the one hand, and to rather loosely aggregated clusters of lime crystals on the other, may sometimes be seen in a single collection. The type species is distinctive; the remaining species have been confused, but on the basis of the material available for study they appear to be distinct.

The present treatment is based in part on an unpublished thesis by Mr. David A. Pierce, on file in the University of Iowa Library, but departs from its conclusions in a number of respects.

KEY TO SPECIES

 Sporangiate, usually stipitate, rarely sessile, the stalk bright orange-brown; wall cartilaginous, bearing relatively few large scales.

L. tigrinum

 Sporangiate to plasmodiocarpous, rarely stipitate, the stalk, when present, never bright orange-brown; wall cartilaginous to membranous, usually bearing numerous medium sized to small scales.

b

b. Capillitium pale yellow-brown, the threads coarse, flattened, forming a net expanding at the nodes, which frequently become vesicular and enclose clusters of lime crystals; spores 15–20 μ.

L. granuliferum

 Capillitium dark, not notably net-like nor bearing vesicular enlargements which may enclose lime crystals; spores rarely over 15 μ.

c

 c. Primarily plasmodiocarpous, less commonly sporangiate and then sometimes with a short, thick, dark stalk; peridium white to brownish gray, subcartilaginous to membranous; spores 13–15 μ.

L. carestianum

 Primarily sporangiate, the sporangia sometimes elongated and subplasmodiocarpous; rarely stalked.

d

 d. Dull gray or drab; peridium subcartilaginous, bearing small, white, limy scales; stalk, when present, dark, weak.

L. chailletii

d. Flesh-colored to cinnamon-brown; peridium tough, membranous, bearing an outer layer of minute vinaceous scales united into a crust; stalk, when present, hyaline, concolorous.

L. crustaceum

Lepidoderma carestianum (Rab.) Rost., Mon. 188. 1874.

FIG. 359 *Plate* XLI Reticularia carestiana Rab., Fungi Eur. 436. 1862.

Didymium nivicolum Meylan, Bull. Soc. Vaud. Sci. Nat. 57: 40. 1929.

Primarily plasmodiocarpous, but varying to sporangiate; plasmodiocarps flattened, irregular, up to 15 mm long and 1 mm thick, often shortened and merging into pulvinate, elongate or ellipsoid sporangia, these rarely with a short, thick, dark stipe; peridium subcartilaginous to tough-membranous, brown or brownish gray, more or less clothed with white or yellowish, usually small, crystalline scales, often so closely aggregated as to form a nearly continuous outer limy wall; columella pulvinate, flattened, white above when well-developed, dark below, spongy within, enclosing crystalline calcareous masses, sometimes reduced to a dark, thickened base; capillitium dark, rather slender, somewhat branched and anastomosing and often bearing dark, bead-like thickenings; spores black in mass, dark purplish brown by transmitted light, rather closely and irregularly warted, globose to broadly elliptical (12-)13-15 μ in diameter. Plasmodium reported as black.

TYPE LOCALITY: Riva, Trentino, Italy.

HABITAT: Plant litter.

DISTRIBUTION: Italy, Scotland, Switzerland, France, Sweden, Rumania; New Hampshire, Massachusetts, Utah, Washington, Oregon, California.

ILLUSTRATION: Lister, Mycet. ed. 3, pl. 115, f. a.

EXSICCATI: Rab., Fungi Eur. 436(TYPE); Jaap, Myxom. Exs. 111; Thaxter, Rel. Farl. 405.

This species, like L. chailletii, is separated from Didymium only by the lime platelets. These are usually apparent but tend to be rather small in both species and are often arranged in a somewhat labyrinthiform pattern; in the same collection, the lime may be in scales in part of the fruitings and in loose, scale-like clusters in another part. L. carestianum tends to be plasmodiocarpous, but a specimen from Washington referred here on the basis of the dark and fairly large spores, $13-14~\mu$, consists mainly of somewhat elongated pulvinate sporangia with only two or three which could be regarded as somewhat plasmodiocarpous. Rostafinski, Mon. 188-9. 1874, with only the type specimens of L. carestianum and L. chailletii available, gave the spore size of the former as $13.8-14.6~\mu$, and of the latter as $10.8-12.5~\mu$.

Didymium nivicolum Meylan was recognized as a valid species by Macbride and Martin (1934), who commented on the scaly outer wall, and stated that it was certainly distinct from D. dubium. Hagelstein (1944) said it was no more than a phase of D. dubium. Martin (1949) accepted Hagelstein's disposition. However, receipt of a very fine specimen from Utah, from Dr. T. E. Brooks, which he had determined as D. nivicolum, led to a re-examination of our syntype of that species. The Utah specimen is in excellent agreement with the syntype, but we now believe that both should be referred to L. carestianum.

Lepidoderma chailletii Rost., Mon. 189. 1874.

FIG. 360 Plate XLI Lepidoderma carestianum var. chailletii (Rost.) G. Lister, Mycet. ed. 2. 140. 1911.

Lepidoderma carestianum var. flavescens Meylan, Bull. Soc. Vaud. Sci. Nat. 44: 292. 1908.

Primarily sporangiate, sessile, subglobose or pulvinate, 0.5–1 mm in diameter, closely aggregated and often fused, merging into short plasmodiocarps, rarely with a weak stalk, dull gray or drab; peridium subcartilaginous, sprinkled

with usually small, white or pale yellowish, crystalline limy scales, these often rather sparse; columella variable, pale to yellowish brown or dark, clavate to hemispherical, sometimes lacking; stalk, when present, dark; capillitium usually abundant, rather rigid, somewhat sparsely branched and anastomosing; spores nearly black in mass, smoky lilaceous brown by transmitted light, spinulose, mostly 10– $13~\mu$ in diameter. Plasmodium dingy white.

TYPE LOCALITY: Hauenstein, Czechoslovakia.

HABITAT: Plant litter, sometimes on living plants.

DISTRIBUTION: Central Europe, Great Britain; Oregon, California.

EXSICCATI: Jaap, Myxom. Exs. 133 (as L. carestianum).

Closely related to *L. carestianum*, of which it has been regarded as a variety and from which it is distinguished mainly by its more sporangiate habit and somewhat smaller and paler spores. The sometimes yellowish colors of the peridium are less constant. The reported difference in the colors of the plasmodia, said to be black in *L. carestianum* and dingy white in *L. chailletii*, if it proves to be constant, may be of additional significance.

Lepidoderma crustaceum Kowalski, Mycologia 59: 167. 1967.

Sporangiate, clustered, sessile on a constricted base or with a short, weak stalk, pale violaceous brown (about light cinnamon-drab Ridgway); sporangia globose or pulvinate, rarely somewhat plasmodiocarpous, mostly 1–1.5 mm in diameter or sometimes elongate; peridium double, the outer layer crustose, composed of tightly compacted minute crystalline calcareous scales, the inner layer fawn-colored, membranous, hyaline, iridescent; columella none, but a limy pseudocolumella often present; stalk, when present, concolorous, hyaline, weak, appearing as an extension of the hypothallus, often appressed in part to the substratum, when erect, rarely attaining half the total height; hypothallus horny, inconspicuous, but staining the substratum dark; capillitium scanty, dark, the main threads 2–3 μ in diameter, sparsely branched and anastomosing, paler and more slender toward the tips, bearing dark, more or less vesicular enlargements; spores black in mass, tending to be agglutinated and discharged from the open sporangium in a mass, globose, dark, coarsely and irregularly warted, 11–13 μ in diameter. Plasmodium unknown.

TYPE LOCALITY: Butte Co., California.

HABITAT: Decaying leaves or twigs near melting snow.

DISTRIBUTION: Known only from type locality. ILLUSTRATIONS: Mycologia 59: 169, f. 1, 2.

This species is known from a number of collections, all from the same limited area, which display a remarkable constancy. The peridium is unique. It is definitely scaly, but the scales are so small and so closely compacted that the effect is that of a *Diderma*. In No. 2640 the spores are paler and more irregular in size than in the other specimens seen, possibly because of somewhat incomplete maturation.

The species is certainly to be included in *Lepidoderma* as at present defined, but differs from previously recognized species in its color, strand-like stalks and particularly in the minute, closely compacted peridial scales.

Lepidoderma granuliferum (Phill.) R. E. Fries, Ark. Bot. 6(7): 3. 1906.

FIG. 361 Plate XLI Didymium granuliferum Phill., Grevillea 5: 114. 1877. Amaurochaete minor Sacc. & Ell., Michelia 2: 566, 1882.

Badhamia granulifera (Phill.) Massee, Mon. 321. 1892.

Lepidoderma carestianum var. granuliferum (Phill.) G. Lister, in Schinz, Mitt. Nat. Ges. Winterthur 6: 63. 1906.

Plasmodiocarps simple or branched, rarely exceeding 10 mm in length, varying to pulvinate or subsporangiate, sessile, often anastomosing, white to pinkish gray or drab; peridium membranous to subcartilaginous, dark gray or dull yellow, sometimes iridescent, coated with limy scales, these sometimes united to form an outer wall remote from the peridium; columella pulvinate, flattened, not conspicuous; capillitium coarse, pale yellow to yellow-brown, branching and anastomosing to form an intricate net with expanded nodes, these frequently forming cysts containing masses of crystalline lime; spores black in mass, dark yellow-brown by transmitted light, paler on one side, densely spinulose, 15-20 µ in diameter. Plasmodium unknown.

TYPE LOCALITY: Blue Cañon, Placer Co., California.

HABITAT: Plant litter; sometimes on living plants.

DISTRIBUTION: California, Utah, Washington; Switzerland, Sweden. ILLUSTRATIONS: Lister, Mycet. ed. 3. pl. 115, b-d (as L. carestianum).

Distinguished from all other Lepidodermas by the pale, broad, densely netted capillitium with expanded nodes which often form cysts enclosing masses of crystalline lime, and by the very large spores.

The species has been greatly misunderstood. Hagelstein's comments (1944, p. 137) are not at all in agreement with our findings. In the University of Lowa collection there is adequate material of the types of Didymium granuliferum and Amaurochaete minor to permit mounts for microscopic study, which are filed in the herbarium. These show that the spores of the type of D. granuliferum are quite regularly 18-20 μ in diameter, with only a few larger spores which are obviously incompletely matured, and, as Hagelstein stated, the lime nodules are present in the capillitium. In the type of A. minor the spores are somewhat smaller, 15-17 μ; those of Harkness 35, also mentioned by Hagelstein, are intermediate, 17-18 μ . Both have the limy cysts in the capillitium. Jaap's 93, collected in Switzerland by Meylan and distributed as L. carestianum, has spores 16-18 μ and characteristic yellow capillitium, but no lime nodules were observed. Several specimens collected by W. B. Cooke on Mt. Shasta, California, have spores in the 15-20 μ range and yellow capillitium; most show the nodules, but some do not. These then, may be lacking or so sparse as not to be present in individual mounts, but even without them the other characters make L. granuliferum more distinct from L. carestianum than is L. chailletii.

FIG. 362 Plate XLI Lepidoderma tigrinum (Schrad.) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. **27–28**: 73. 1873.

Didymium tigrinum Schrad., Nov. Gen. Pl. 22. 1797.

Physarum squamulosum Pers., Syn. Fung. 174. 1801.

Physarum tigrinum (Schrad.) Pers., Syn. Fung. 174. 1801.

Trichia squamulosa (Pers.) Poir., in Lam. Encyc. 8: 53. 1808.

Trichia tigrina (Schrad.) Poir., in Lam. Encyc. 8: 53. 1808.

Leangium squamulosum (Pers.) Fries, Stirp. Fems. 83. 1826.

Didymium rufipes Fries, Syst. Myc. 3: 116. 1829.

Lepidoderma fulvum Massee, Mon. 253. 1892.

Sporangia stipitate, rarely sessile, subglobose, somewhat flattened and umbilicate below, gregarious or scattered, 0.8–1.5(–1.8) mm in diameter, total height up to 2.8 mm, olive or purplish gray, the surface incompletely covered by rounded or angular plates of crystalline lime; peridium cartilaginous, opaque, dark gray or dull orange-brown; stalk 1–2 mm tall, rarely shorter, stout, furrowed, bright orange-brown, spongy, with orange lime crystals secreted inside; hypothallus dull yellow or orange-brown; columella large, hemispherical, similar to the stalk and containing similar lime crystals; capillitium profuse, the dark, sparingly branched, straight or flexuous threads radiating from the columella; spores black in mass, dull grayish brown by transmitted light, minutely spinulose, $10-13~\mu$ in diameter. Plasmodium orange-yellow.

TYPE LOCALITY: Germany.

HABITAT: Rotten coniferous wood among mosses and lichens.

DISTRIBUTION: Widely distributed in Europe and temperate North America, in coniferous forest areas, but apparently not common; India.

ILLUSTRATIONS: Schrad., Nov. Gen. Pl. pl. 6, f. 2, 3; Rost., Mon. pl. 9, f. 159, 160; Lister, Mycet. ed. 3. pl. 114; Univ. Iowa Stud. Nat. Hist. 14(8), pl. 4, f. 28; Macbr. & Martin, Myxom. pl. 10, f. 212, 213; Hagelst., Mycet. N. Am. pl. 10, f. 4.

EXSICCATI: Jaap, Myxom. Exs. 48, 155; Brândză, Myxom. Roum. II. 1: 15(NY); 84(IA).

A striking and distinctive species. As noted under *Didymium leoninum*, it is closely related to that species, but the smaller spores and paler color of *D. leoninum*, and particularly its large, stellate crystals, which are sharply distinct from the prominent plate-like scales of *L. tigrinum*, appear to be constant.

According to Hagelstein (1944), L. tigrinum fruits late in the season and he suggests that may account in part for its rather infrequent collection.

Berlese, in Sacc., Syll. 7: 306. 1888, cited Diderma citrinum Berk., in Smith, Engl. Fl. 5(2): 310, 1836, as a definite synonym of L. tigrinum, as did G. Lister, Mycet. ed. 3: 125, adding "(non Schum.)." Physarum citrinum Schum., Enum. Pl. Saell. 2: 201. 1803, is the basionym of Diderma citrinum (Schum.) Fries, Syst. Myc. 3: 100. 1829, hence there is no "Diderma citrinum Schum." "D. citrinum Peck," cited by G. Lister, was published by Peck as D. citrinum Fries, and later corrected, as noted under Physarum flavidum. We have not seen Berkeley's publication of D. citrinum, but it seems probable that it was no more than a misapplication of Fries's binomial.

The var. gracile Meylan, Bull. Soc. Bot. Genève II. 2: 263. 1910, is said to have stalks 2-3 times the height of the sporangium. Such forms occur in our California material, usually intermixed with those with shorter stems. The varietal name seems superfluous.

EXCLUDED AND DOUBTFUL SPECIES

Lepidoderma kurtzii Berk. ex Massee, Mon. 255. 1892.

Listed as doubtful by Massee, on basis of Berkeley's notes, since specimen was not found. G. Lister, in second and third editions of Lister monograph, cited it as a possible synonym of *Physarum tenerum*.

Lepidoderma mandshurica Skvortz., Philipp. Jour. Sci. 45: 88. 1931.

The description and illustrations suggest L. chailletii except that the spore size is given as $6.8-7.2 \mu$. If this can be verified and proves constant, the species may be worthy of recognition.

Lepidoderma obovatum Massee, Mon. 254. 1892.

As noted by A. Lister, Mon. 107. 1894, the figures given by Massee refer to other species. G. Lister, in the second and third editions of the monograph, cited Massee's species as a doubtful synonym of *Diderma trevelyani*.

Lepidodermopsis vermiculare Wilcz. & Meylan, Bull. Soc. Vaud. Sci. Nat. 58: 179. 1934.

The type species of Lepidodermopsis Wilcz. & Meylan, l.c., not Lepidodermopsis Höhn. 1909. This appears to be based on prematurely dried fruitings of a Lepidoderma, quite possibly L. chailletii, with which its resemblance is noted in the original publication.

In the preparation of this volume it has been necessary to establish the status of many names met with in the literature; the majority have been included in the synonymy or in the lists of doubtful species following the genera. Those which at the time of study could not be so placed were entered on index cards, and the following list was compiled from such cards.

Many were validly published but their application is uncertain; a few of these, when investigated, may prove to be valid over names in current use. In others, the validity has not been clearly established on the basis of the information available to us. Still others seem to be clearly invalid; such are enclosed in quotation marks.

Few varieties and no forms are included. Most of these are based on trivial differences which are well within the usual limits of variation to be expected in a species, and we see no advantage in citing them.

The desirability of a list such as this is very largely due to the unfortunate provision of the International Code of Botanical Nomenclature, which makes Linnaeus, Species Plantarum, ed. 1. 1753, the starting point for the nomenclature of Myxomycetes. Even before that date, a few clearly recognizable species had been described, always, of course, in works using polynomials. A number of them, reduced to binomials, have crept into the literature, and some of these appear to have been validated by later publication. The same is true of certain polynomials published after 1753. The first adequate treatment of the group was by Persoon, in the Synopsis Methodica Fungorum, 1801. Fries, Systema Mycologicum 3: 67-198. 1829, presented an excellent and comprehensive treatment. Persoon's work would have made an acceptable starting point; Fries's would have been even better. Between 1753 and 1829 many names were proposed, some quite unmistakable in their application, but the great majority inadequately described and some so poorly delimited that even the genus involved is impossible to determine with any assurance. It was not until the middle of the 19th century that microscopic details, so important in modern classification, came into general use. These were first extensively incorporated in the Rostafinski monograph of 1874-1876, written in Polish, but generally followed by Berlese, who made important additions, and wrote in Latin, in volume 7 of Saccardo's Sylloge Fungorum, 1888. However, making either Rostafinski or Berlese the starting point, as has been suggested, would involve radical changes in current usage, probably more than would be required if either Persoon or Fries were to be selected for that purpose. Since the present volume attempts to reflect current usage, it has been necessary to work under the current Code, but to interpret the application of its provisions with some latitude.

It must be emphasized that the list is not complete. Within its limitations, however, it will, when added to the names included in the index, perhaps help to prevent the reuse of these names for new species, thus creating unnecessary homonyms, without adequate investigation of their availability. For this reason, it has seemed to be desirable to add some names published too late to be inserted in the text, many of which should probably be accepted.

Aethalium geophilum Peck, Ann. Rep. N. Y. State Mus. 31: 57. 1879.

Mentioned incidentally as probably *Hyphelia terrestris* Peck, an imperfect fungus. Original publication not found.

"Aethalium microscopica Wallr., Herb.!"

Cited by Rostafinski, Mon. 219. 1875, as a synonym of Licea flexuosa Pers.

"Aethalium minimum Wallr. in litt.!"

Cited by Rostafinski, Mon. 219. 1875, as a synonym of Licea flexuosa Pers.

Aethalium rufum Aleksandr. t. 11, f. 6-11.

So cited by Berlese, in Sacc. Syll. Fung. 7: 354. 1888, as a synonym of Fuligo septica. Reference not located. If proposed as new, a later homonym of A. rufum (Pers.) Wallr.

"Arcyria anomala de By. msc."

Cited by Rostafinski, Mon. 289. 1875, as a synonym of Cornuvia serpula.

Arcyria cincta Schum., Enum. Pl. Saell. 2: 215. 1803.

Cited by G. Lister, Mycet. ed. 3. 235. 1925, as a possible synonym of A. denudata. "Arcyria cinnamomea Kaulfuss msc."

Cited by Rostafinski, Mon. 279. 1875 as a synonym of A. dictyonema Rost. (A. ferruginea of present treatment).

Arcyria coccinea (Bull.) Duby, Bot. Gall. 2: 857. 1830.

Name based on Sphaerocarpus coccineus Bull. and Trichia coccinea (Bull.) DC. Identity doubtful.

"Arcyria lateritia de By."

Rost. Mon. 279. 1875. Publication not found.

Arcyria lilacina Quél., Assoc. française av. Sc. Supp. 13: 8. 1884.

Not seen. If described as new, a later homonym of A. lilacina Schum.

Arcyria major (G. Lister) B. Ing, Trans. Brit. Mycol. Soc. 50: 556. [1967] 1968. Basionym: Arcyria insignis var. major G. Lister, Mycetozoa ed. 3: 236. 1925.

"Arcyria ochracea de By. msc."

Rost. Mon. 279. 1875. No record of valid publication found.

"Arcyria pallens Wallr. In lit.!"

Rost. Mon. 277. 1875, and copied in later works. No record of valid publication found.

"Arcyria pedicula Hill"

Berlese, in Sacc., Syll. Fung. 7: 426. 1888. Surely pre-Linnaean.

Arcyria rosea Spreng.

Cited, without bibliographical reference, in Rostafinski, Mon. 276. 1875, as a synonym of A. incarnata. No publication record has been found. A. rosea, without author citation, is mentioned by Persoon in legend to pl. 5, f. 4–5, in Ann. Bot. Usteri 20: 128. 1796 (pl. 5 lacking in our copy). The inference is that A. rosea was published by Persoon in Obs. Myc. 1796.

"Arcyria sessilis Hill"

Berlese, in Sacc. Syll. Fung. 7: 428. 1888. Cited without reference. Surely pre-Linnaean.

Arcyria viridis Zoll., Nat. Genees. Arch. Neerl. Ind. 1: 377. 1844.

Description, reprinted in Flora 3: 300. 1847, suggests a small, bright green Arcyria, not unlike A. glauca.

"Arongylium atrum Link," Ges. Nat. Freunde Berlin Mag. 3: 24. 1809.

Link published the combination only by inference in the paper cited, and Arongylium was a printer's error for Strongylium, corrected by Link in 1815. The actual combination was first published by Swartz, in 1815, based on Lycogala atrum Alb. & Schw., Consp. Fung. 83. 1805.

Badhamia dubia Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 71: 49, f. 6. 1968.

Close to *B. utricularis*, differing in its sessile habit and in its smaller and more strongly clustered spores which are conspicuously warted on the exposed ends.

Badhamia incarnata Oudem.

Cited by Rostafinski, Mon. Index 357. 1875 as uncertain. Reference possibly to Oudemans, 1872, n. v.

"Badhamia rubiginosa (Chev.) Cooke, Myxom. Gt. Brit. 82. 1877."

Cited by Berlese, in Sacc., Syll. Fung. 7: 334. 1889. Not a new combination by

Cooke, merely a correction of an earlier page substituting Rostafinski's combination of 1876 for that used in 1875.

"Bovista miniata Dill., Cat. pl. 197. 1719."

Cited by Berlese, in Sacc., Syll. Fung. 7: 435. 1888, as a synonym of "Lycogala epidendrum Buxb.," and often copied by later authors. Both names, as so cited, pre-Linnaean.

Byssus bombycina Retz., Sv. Vet.-Akad. Handl. 30: 251. 1769.

Cited by Berlese, in Sacc., Syll. Fung. 7: 388. 1888, in synonymy of Spumaria alba. We have been unable to verify the reference.

Ceratium rubicundum Ehrenb. ex Link, Handb. Gew. 3: 433. 1833.

There may be an earlier valid publication, but if so, we have not seen it. Cited by Saccardo, Syll. Fung. 4: 596. 1886, as a synonym of *C. hydnoides*, referring to "Link Sp. II, p. 119" which we have not located.

Chondrioderma spumarioides var. carcerina Rost., Mon. 175. 1874.

Rostafinski's pl. 8, f. 142-145, show globose sporangia not immersed in the hypothallus, which suggests *Diderma globosum*, but that is far from certain.

Cionium carolinense Spreng., Syst. 4(1): 529. 1827.

Not recognizable from description. Lycoperdon transversarium Bosc, cited as synonym.

"Cionium complanatum Link ex Wallr., Fl. Crypt. Germ. 2: 365. 1833."

Possibly based on *Didymium complanatum* Schrad., now regarded as a synonym of *D. melanospermum* (Pers.) Macbr.

Cionium farinaceum (Schrad.) Nees, Syst. Pilze Schw. 114. 1816.

Cited by Berlese, in Sacc., Syll. 7: 377. 1888, as a synonym of Didymium squamulosum, citing Nees's pl. 9, f. 106B. Nees's name is based on Physarum farinaceum (Schrad.) Pers., generally believed to be the species here listed as Didymium melanosporum, but the figure does suggest D. squamulosum.

Cionium physaroides (Link) Spreng., Syst. 4(1): 529. 1827.

Based on Leangium physaroides Link, q.v.

Cionium senegalense Spreng., Syst. 4(1): 529. 1817.

Not recognizable from description. Lycoperdon axatum Bosc cited as a synonym.

"Cionium tigrinum Link., Handb. Gew. 3: 410. 1833."

Cited in Rostafinski, Mon. 188. 1874, and copied by Cooke, Berlese and Massee. No such name is given in the work cited.

"Clathroidastrum obscurum Mich., Nov. Pl. Gen. 215. 1729."

Micheli's pl. 94, f. 2 is cited by Berlese, in Sacc., Syll. 7: 394. 1888, as a synonym of Comatricha typhina, pl. 94, f. 1, and, with the same binomial, is cited on p. 397 as a synonym of S. fusca. Micheli's names were not binomials and are of course pre-Linnaean, and later citations as such do not validate them, but they are not infrequently cited in the literature.

"Clathroides flavescens Haller, t. 1, f. 7."

Cited by Berlese, in Sacc., Syll. 443. 1888, as a synonym of *Trichia chrysosperma*. This must be a reference to Haller's publication of 1755 or of 1768. In neither did Haller use binomials regularly, but names so cited are often copied in the literature.

"Clathroides flavescens Micheli, Nov. Pl. Gen. 214. 1729."

Cited by Berlese, in Sacc., Syll. 429. 1888, as a synonym of Arcyria nutans. Comment under Clathroidastrum obscurum applies to this species also.

"Clathroides longissimum Haller, p. 10."

Cited by Berlese, in Sacc., Syll. 429. 1888, as a synonym of Arcyria nutans. See comment under C. flavescens Haller.

"Clathroides pyriforme Haller, pl. 1, f. 5."

Cited by Berlese, in Sacc., Syll. 447. 1888, as a synonym of Hemiarcyria rubiformis. See comment under C. flavescens.

"Clathroides purpureum Micheli, Nov. Pl. Gen. 214. 1729."

Cited by Berlese, in Sacc., Syll. 428. 1888, as a synonym of Arcyria adnata. See comment under C. flavescens.

Clathrus flavus Bolt., Hist. Fung. 3: 94, pl. 93, f. 4. 1789.

Validly published, but not recognizable.

Clathrus olivaceous Bolt., Hist. Fung. 3: 94, pl. 94, f. 2.

Validly published, but not recognizable.

Clathrus pedatus Schmidel, "Icon. tab. 33, f. 1, 17."

Cited by Berlese, in Sacc., Syll. 7: 447, as a synonym of *Hemiarcyria clavata*. Originally published in 1747, Schmidel's book was again printed in 1762 and again, apparently revised, in 1793–1797, hence his names may have been validly published.

"Clathrus pediculatus Guettard, Obs. pl. 1: 16. 1747."

Cited by Berlese, in Sacc., Syll. 7: 426. 1888, as a synonym of Arcyria punicea. Pre-Linnaean.

Clathrus peduncularus Batsch, Elench. Fung. 143. 1786.

Cited by Berlese, in Sacc. Syll. 7: 426. 1888, as a synonym of Arcyria punicea Pers. Doubtful.

Clathrus pertusus Batsch, Elench. Fung. 143. 1786.

Cited by Willdenow, Fl. Berol. 408. 1787 as a synonym of Stemonitis fusca; by Berlese, in Sacc., Syll. 394. 1888, of Comatricha typhina. Berlese cites Batsch's f. 176, illustrating Embolus pertusus (Batsch) Batsch, which does suggest the Comatricha more than it does the Stemonitis.

Clathrus ramosis Retzius, Sv. Vet.-Akad. Handl. 30: 253, 1769.

Berlese, in Sacc., Syll. 7: 428. 1888, cites var. α of Retzius' species as a synonym of Arcyria adnata, and on p. 429, his var. β as a synonym of Arcyria nutans. We have not seen the original paper.

"Clathrus sphaerocephalus Bolt., Hist. Fung. 3: 94. 1789."

Cited by Rostafinski, Mon. Index 360. 1875 as doubtful. Bolton ascribed the binomial to Relhan.

Clathrus sphaerocephalus Relhan, Fl. Cantab. Suppl. 1: 31. 1786.

Cited by Rostafinski, Mon. 154. 1874, as a synonym of *Didymium farinaceum*, and this is accepted by Berlese, in Sacc., Syll. 381. 1888. This name is too doubtful in its application to warrant using its epithet for *D. melanospermum*.

Comatricha amoena Nann.-Brem., K. Ned. Akad. Wet. C. 71: 45, f. 4. 1968.

Resembling Stemonitis fusca, but smaller, not fruiting in tufts, and with surface net incomplete above.

Comatricha reticulospora B. Ing & Holland, Trans. Brit. Mycol. Soc. 50: 685. [1967] 1968.

Spores 6–10 μ , warted-reticulate.

"Cornuvia schweinitzii Berk, in Herb."

Cited by Massee, Mon. 52. 1892 as a synonym of Clathroptychium rugulosum (Wallr.) Rost.

"Craterium aureum Fuckel," ex Berlese, in Sacc., Syll. 7: 356. 1888.

Probably an error.

"Craterium aureum Schum.," in Morgan, Jour. Cinc. Soc. Nat. Hist. 19: 15. 1896. Now invalid as published.

Craterium difforme Fries

Listed, without citation, in Rostafinski, Mon. Index 360. 1875, as uncertain. We have been unable to find publication.

"Craterium minutum Kickx"

Not validly published; if it had been, it would have been a later homonym of C. minutum (Leers) Fries. Cited by Rostafinski, Mon. App. 14. 1876 as a synonym of his Tilmadoche hians, and used by Berlese, in Sacc., Syll. 7: 361 as the basionym of T. minuta (Kickx) Berl. See A. Lister, Mycet. 69. 1894, for an account of the history of the name. All recent authors have agreed with Lister that these names apply to Physarella oblonga.

Cribraria colossea Speg., Ann. Mus. Nac. Buenos Aires 19: 258. 1909.

The description in Sacc., Syll. Fung. 22: 807. 1913, suggests a robust species, the large sporangia borne on long compacted stalks, with the comment "Cr. argillaceae peraffinis sed certe distincta."

"Cribraria microcarpa Macbr."

Cited by G. Lister Mon. ed. 3. 195. 1925, to indicate supposed misapplication by Macbride of C. microcarpa (Schrad.) Pers.

Cribraria mutabilis Quél., Assoc. française av. Sci. Suppl. 13: 8. 1884.

Description not seen.

Cribraria? perpusilla Speg., Anal. Soc. Ci. Argent. 26: 60. 1890.

The description does not suggest a Cribraria. Possibly not a myxomycete.

"Dermatricha flagellifer Cooke Ms."

Cited by Massee, Mon. 127. 1892, as synonym of *Prototrichia flagellifer* (Berk. & Br.) Massee. Neither genus nor species validly published.

"Diachea elegans Fries, Syst. Orbis Veg. 143. 1825."

Cited by G. Lister, Mon. ed. 3. 102. 1925, as a synonym of *Diachea leucopodia*. As cited under that species, Fries did not publish the combination until 1829.

Diachea fulgens Fries ex Weinm., Fl. Ross. 611. 1836.

Identity uncertain. See Rost., Mon. 191. 1874; G. Lister, Mycet. ed. 3. 104. 1925.

Diachea silvaepluvialis Farr, Contr. U.S. Nat. Herb. 37: 409, f. 1, 2. 1969.

Stalk dark brown; lime white, crystalline.

Dianema aggregatum Kowalski, Mycologia 59: 1081, f. 10-12. [1967] 1968.

Not depressed, peridium persistent; spores $8-10\mu$, with complete reticulation.

Dianema subretisporum Kowalski, Mycologia 59: 1080, f. 7-9. [1967] 1968.

Not depressed, peridium evanescent; spores $12-13\mu$, with incomplete reticulation.

Dichosporium aggregatum Nees, Syst. Pilze Schw. 105. 1816.

Probably not a myxomycete.

Dictydium operculatum Bong.

Cited by Rostafinski, Mon. 363, index. 1876, as in part Enerthenema elegans. Reference may be to Bongard, Descr. pl. nov. 1839 (n. v.).

Dictydium trichioides Chev., Fl. Par. 1: 327. 1826 (n. v.)

This is cited as *Cribraria trichioides* Chev., as a synonym of *D. cancellatum* in the present work. The citations are confusing. See Fries, Syst. Myc. 3: 166. 1829; Rost., Mon. 230. 1875, and repeated in Berlese and Massee. The latter three all refer to Corda. Ic. Pl., 5. pl. 3, f. 36, labelled *D. umbilicatum*. Whether Chevallier published his name in *Cribraria* or *Dictydium* we do not know.

Dictydium trichioides (Bull.) Fries, Syst. Myc. 3: 166. 1829.

Based on Sphaerocarpus trichioides Bull., pl. 387, f. 2, which can scarcely be regarded as representing Dictydium cancellatum.

Diderma brooksii Kowalski, Mycologia 60: 594, f. 1. 1968.

Distinguished by its dark capillitium forming a close reticulum with few free ends.

Diderma carneum Nann.-Brem. K. Ned. Akad. Wet. Proc. C. 71: 198, t.f. 8. 1968.

Described as close to *D. montanum* var. *roseum* Meylan, from which it differs in the angular stalk and the large and sparsely distributed spines on the spores.

Diderma cingulatum Nann.-Brem. K. Ned. Akad. Wet. Proc. C. 71: 191, pl. 1, f. 7, 8; t.f. 1. 1968.

Columella long, slender, often clavate, and spores encircled by a pale, narrow band, making them appear apiculate in outline. General appearance that of *D. lyallii*, but less robust.

"Diderma compactum (Ehrenb.) Wallr. Herb."

Rost., Mon. 99. 1874. Not validly published.

Diderma neesii Corda, Ic. Fung. 2: 23. 1838.

Cited by Rostafinski, Mon. 178. 1874, as a synonym of Chondrioderma difforme, "p.p." in index. Corda's pl. 12, f. 88 suggests a Diderma, rather than a Didymium.

Diderma nigrum Kowalski, Mycologia 60: 601, f. 3, 4. 1968.

Dark brown to black; peridium of three layers, the middle layer not crystalline.

Diderma rufum Nann.-Brem. K. Ned. Akad. Wet. Proc. C. 71: 167, t.f. 7. 1968.

Differing from *D. radiatum* in the longer stalks, the simple peridium, which is red-brown within, the dark brown columella and larger spores.

Diderma subcaeruleum Kowalski, Mycologia 60: 598. 1968.

Peridium blue-gray to steel-gray, of two closely united layers.

"Diderma vitellinum Link, Herb."

Cited by Rostafinski, Mon. 108. 1874, as a synonym of *Physarum conglomeratum* (Fries) Rost. No record of valid publication found.

Diderma zeylanicum Berk. & Br., Jour. Linn. Soc. 14: 84. 1873.

Not recognizable from description. See Rost., Mon. 167. 1874, where publication is given to what is presumably Jour. Bot. & Kew Misc. 6: 230. 1854 (n. v.).

Didymium daedaleum Berk. & Br., Ann. Mag. Nat. Hist. II. 3: 336. 1850.

G. Lister, Mon. ed. 3. 56. 1925, gives an extended discussion of this species, which she thought was probably *Physarum gyrosum*.

Didymium hemisphaericum Berk., in Smith, Engl. Fl. 5(2): 312. 1836.

Not D. hemisphaericum (Bull.) Fries. Cited by Rostafinski, Mon. 172. 1874, as a synonym of Chondrioderma michelii (Lib.) Rost. Berkeley may not have intended it as new. At any rate all are now included in Diderma hemisphaericum.

"Didymium hemisphaericum Fuckel, Jahrb. Nass. Ver. Nat. 23-24: 241. 1870."

Cited by Rostafinski, Mon. 114. 1874, as a synonym of *Physarum leucophaeum*. Fuckel cited (Bull.) Fries as the authors.

"Didymium leucopus de By., Mycet. 9. 1864."

Cited by Rostafinski, Mon. 159. 1874, as a synonym of *D. squamulosum*. There is no suggestion that de Bary intended this to refer to a new species.

Didymium linkii Fries

Cited by Rostafinski, Mon. Index 366. 1875, without citation, as doubtful. We have not found publication.

Didymium liquidum Payer

Cited by Rostafinski, Mon. Index 366. 1875, without citation, as doubtful. Publication probably in Payer, Bot. Crypt. Paris, 1850 (n. v.).

Didymium muscicola Link

Cited by Rostafinski, Mon. Index 367. 1875, as doubtful. Probably in error for *Diderma muscicola* Link, 1809.

Didymium nanum Fries, in Weinm., Fl. Ross. 1836 (n. v.).

Cited by Rostafinski, Mon. Index 367, 1875, as uncertain. Name printed in Fl. Veg. Scand. 452. 1848.

Didymium physaroides Klotsch

Cited by Rostafinski, Mon. 155. 1874, as a synonym of *Didymium farinaceum*. Exsiccati dated 1832–55. Validity not established, but if valid, a later homonym of *D. physaroides* Fries.

Didymium physaroides Lettelier, Fig. Champ. 1829 (n. v.).

Cited by Rostafinski, Mon. Index 367. 1875, as a synonym of *Physarum cinereum*. Validity not established. See preceding.

Didymium physaroides Mont., Fl. Alg. 112. 1846. Not D. physaroides Fries.

Cited by Rostafinski, Mon. 95. 1874, as a synonym of *Physarum lividum*. Validity not established. See Sacc., Syll. Fung. 7: 338. 1888.

Didymium reticulatum Bisch., Kryptogamenkunde, f. 3621. 1842.

So cited by Rostafinski, Mon. 91. 1874, as a synonym of Cienkowskia reticulata. Reference presumably to G. W. Bischoff, Handb. Bot. Term. Syst. 2. 1842.

Embolus lacteus Hoffm., Veg. Crypt. 2: 8. 1790.

Cited by Rostafinski, Mon. 252. 1875, as a synonym of Trichia varia, "p.p." in index.

Embolus lacteus Jacq., Misc. Austr. 1: 137, pl. 6. 1788.

Cited by Rostafinski, Mon. 198. 1874 as a synonym of Comatricha typhina, "p.p." in index.

Embolus pertusis Batsch, Elench. Fung. Contin. 1: 263. 1783.

Cited by Rostafinski, Mon. 198. 1874, as a synonym of Comatricha typhina, "p.p." in index. Batsch's f. 176 on pl. 30, does suggest it.

Enteridium antarcticum Speg., Bol. Acad. Nac. Ci. Cord. 11: 277. 1887.

Cited by G. Lister, Mon. ed. 3. 193. 1895 as a possible synonym of E. olivaceum.

"Fuligo cerea Sow., Eng. Fungi, pl. 399, f. 4. 1803."

Cited by Rostafinski, Mon. 369. 1875 as a synonym of F. varians "p.p." Neither Sowerby's figure nor his comment justifies regarding this as validly published.

"Halterophora fulva Endl., Gen. pl. 25. 1836."

Cited by Rostafinski, Mon. 369. 1875, as doubtful. Endlicher did not publish the

binomial except by implication, citing *Tipularia fulva* Chev., Jour. de Physique 92: 58. 1822; the combination in *Halterophora* was made by O. Kuntze, Rev. Gen. Pl. 3(1): 855. 1893.

"Hemitrichia bucknallii Massee"

G. Lister, Mycet. ed. 3. 207. Error for Hemiarcyria.

Hystricapsa trochiformis Preuss, Linnaea 24: 140. 1851.

See Sacc., Syll. Fung. 18: 797. 1906. Probably not a myxomycete.

"Lachnobolus incarnatus Macbr.," Bull. Nat. Hist. Iowa 2: 126. 1892.

Cited by G. Lister, Mycet. ed. 3. 241. 1925. Macbride assigned his specimens to L. incarnatus (Alb. & Schw.) Schroet.

Leocarpus melaleucus Mont., Ann. Sci. Nat. IV. 3: 141. 1855.

Cited by Rostafinski, Mon. 142. 1874, as a synonym of Physarum sinuosum.

Licea berteroana Mont., in Gay, Hist. Chile 8: 20. 1852.

Not a myxomycete. Berlese, in Sacc., Syll. 7: 406. 1888.

Licea epiphylla Schw., Trans. Am. Phil. Soc. II. 4: 259. 1832.

Probably a myxomycete, but not recognizable from description; probably not a Licea.

Licea guaranitica Speg., Anal. Soc. Ci. Argent. 22. No. 322. 1886.

Cited by Massee, Mon. 39. 1892, as basionym of *Tubulina guaranitica* Roum., Fungi Sel. 5196. 1890, q. v.

Licea incarnata Preuss

Cited by Rostafinski, Mon. 372. 1875, without reference, as doubtful. May have been published by Preuss in Linnaea 24. 1851. If so, a later homonym of *L. incarnata* Alb. & Schw.

Licea inquinans Spreng., Syst. 4(1): 524. 1827.

Cited by Rostafinski, Mon. 372. 1875, without reference, as a possible synonym of *Amaurochaete atra*, "p.p.". Presumably based on *Dermodium inquinans* Link, 1809.

Licea lignatilis Beck.

Cited by Rostafinski, Mon. 372. 1875, without reference, as doubtful. Reference presumably to J. Becker, Fl. Frankf. 1828, n. v.

Licea macrospora Schum., Enum. Pl. Saell. 2: 219. 1803.

Cited by Fries, Summa Veg. Scand. 459. 1848, as a synonym of his Lignyota umbrina, q. v.

Licea macrospora Schw., Trans. Am. Phil. Soc. II. 4: 258. 1832.

Cited by Rostafinski, Mon. 228. 1875, as a synonym of Lignyota umbrina Fries. Possibly a mistake for preceding in view of Fries's citation. Schweinitz published his name as new. Its identity is not known, but the name, although a later homonym of that of Schumacher, was validly published.

Licea strobilina Alb. & Schw., Consp. Fung. 109, pl. 6, f. 3. 1805.

Believed to be a rust. See Berlese, in Sacc., Syll. Fung. 7: 406. 1888. The species has been transferred as a myxomycete to *Perichaena*, *Tubifera* and *Phelonitis*.

"Licea strobilina Fries"

Cited by Rostafinski, Mon. 372. 1875, without reference, as uncertain. We have found no such combination by Fries. In both Symb. Gast. 11. 1817 and Syst. Myc. 3: 191. 1829, Fries cites *L. strobilina* Alb. & Schw. as a synonym of *Perichaena strobilina* (Alb. & Schw.) Fries.

Licea suberea (Chev.) Fries, Syst. Myc. 3: 198. 1892.

Based on *Phelonitis suberea* Chev. Probably not a myxomycete.

Licea synsporos Nann.-Brem., K. Ned. Akad. Wet. C. 71: 42, f. 2. 1968. Subglobose, with strongly clustered spores.

Lignidium quercinum Fries, Stirp. Femsj. 83. 1826.

Cited by Rostafinski, Mon. 190. 1874, as a synonym of *Cornuvia circumscissa* (Wallr.) Rost., "p.p." in index; accepted without question by Berlese, in Sacc., Syll. 7: 422. 1888. Probably a *Perichaena* but species doubtful.

Lignyota nigra Fries, Summa Veg. Scand. 459. 1849.

Cited by Rostafinski, Mon. App. 17. 1876, as a synonym of Chondrioderma liceoides Rost., now a synonym of Didymium difforme.

Lignyota umbrina Fries, Summa Veg. Scand. 459. 1849.

Identity not known. See Rost., Mon. 228. 1875.

Lycogala argentea Pers., Tent. Disp. Fungi 7. 1797.

This has been associated with Reticularia lycoperdon, Lycogala flavofuscum and other species. Pending reexamination of Persoon's type, if it still exists, it must be regarded as a nomen confusum.

"Lycogala globosum Micheli," Nova Gen. Pl. 216, pl. 95, f. 3, 1729.

Cited by Berlese, in Sacc., Syll. 7: 435. 1888, as a synonym of *L. epidendrum*, which it probably is. Micheli's name was a polynomial and pre-Linnaean, but it may have been validated by Schrank, Baier. Fl. 1789, n.v., since Rost., Mon. 373. 1875, cites it as *L. globosum* Schrk.

"Lycogala luteum Micheli," Nova Gen. Pl. 216, pl. 95, f. 4. 1729.

Cited by Berlese, in Sacc., Syll. Fung. 7: 442. 1888, as a synonym of *Trichia varia*. Pre-Linnaean and a polynomial, and never, so far as we know, validated. Its identity extremely doubtful.

Lycoperdon alni Bjer. in Vet. Handl. p. 39.

Cited by Berlese, in Sacc., Syll. 7: 344. 1888, as a synonym of *Physarum cinereum*. Reference not found.

Lycoperdon aggregatum Liljeb., Fl. Scan. 858.

Cited by Berlese, in Sacc., Syll. 7: 439. 1888, as a synonym of *Trichia fallax*. Reference may be to Liljeblad, Sv. Fl. 1792 or ed. 2. 1798. In either case, if published as new, a later homonym of the following.

Lycoperdon aggregatum Retz., Fl. Scan. 1627.

Cited by Berlese, in Sacc., Syll. 7; 443. 1888, as a synonym of *Trichia chrysos-perma*. Reference to Retzius, Fl. Scand. 1779.

Lycoperdon bombacinum Batsch, El. Fung. 153. 1783.

Cited by Rostafinski, Mon. 247. 1875, as a synonym of *Trichia fragilis* (Sow.) Rost., based on *Sphaerocarpus fragilis* Sow., Engl. Fungi, pl. 279. 1800.

Lycoperdon coccineum Raf., Jour. de Bot. (Desv.) 1: 237. 1813.

Listed by Fischer, in Sacc., Syll. Fung. 7: 132. 1888 among doubtful species. The very brief description suggests *Lycogala epidendrum*.

Lycoperdon cylindricum With., Brit. Pl. [ed. 2. 3: 414. 1792?]

Cited by S. F. Gray, Nat. Arr. 1: 574. 1821, as a synonym of Leocarpus parasiticus.

Lycoperdon echiniforme Sow., Engl. Fungi, pl. 400, f. 1. 1803.

Cited by Berlese, in Sacc., Syll. 7: 402. 1888, as a synonym of *Brefeldia maxima*. This is extremely doubtful.

"Lycoperdon epidendrum Sow.," Engl. Fungi, pl. 400, f. 2-3. 1803.

Cited by Berlese, on same page as preceding, as an additional synonym of *Brefeldia maxima*. Sowerby never intended this as a new name, nor do the figures cited suggest *Brefeldia*.

Lycoperdon epiphyllum Huds., Fl. Angl. ed. 2. 645. 1778, n. v.

Cited by Rostafinski, Mon. 286. 1875, as a synonym of Lycogala epidendrum. If published as new, a later homonym of following.

Lycoperdon epiphyllum Lightf., Fl. Scotl. 1069. 1777, n. v.

Cited by Rostafinski, Mon. 255. 1875, as a synonym of Trichia chrysosperma.

Lycoperdon ferrugineum R. A. Hedw., Obs. bot., fasc. 1, pl. 10, f. 1-4. 1802, n.v.

Cited by Rostafinski, Mon. 262. 1875, as a synonym of Hemiarcyria rubiformis.

Lycoperdon fuscum Huds., Fl. Angl. ed. 2. 645. 1778, n.v.

Cited by Rostafinski, Mon. 241. 1875, as a synonym of Reticularia lycoperdon.

Lycoperdon gregarium Retz., Obs. bot. 1: 33. 1779.

Cited by Rostafinski, Mon. 253. 1875, as a synonym of Trichia chrysosperma.

Lycoperdon hypoxylon Pallas, Reise 2: 503. 1771.

Cited by Rostafinski, Mon. 275. 1875, as a synonym of Arcyria incarnata.

Lycoperdon luridum R. A. Hedw., Obs. Bot., pl. 11a. 1802.

Cited by Rostafinski, Mon. 375. 1875, as a synonym of Trichia varia "p.p"

Lycoperdon luteum Jacq., Misc. 139, pl. 8. 1778.

Cited by G. Lister, Mycet. ed. 3. 60. 1925, as a doubtful synonym of *Physarum contextum*. Possibly not to be regarded as a binomial, although so listed on p. 211. Surely not a myxomycete; probably a hypocreaceous fungus.

Lycoperdon luteum Schrank, Baier. Fl. 2: 629. 1789.

Cited by Rostafinski, Mon. 135. 1874, as a synonym of Fuligo varia. If Jacquin's name was validly published, this is a later homonym.

Lycoperdon sphaericum Gled., Meth. Fung. 150. 1753.

Pre-Linnaean, and not a binomial as published.

Lycoperdon stipitatum Retz., Sv. Vet.-Akad. Handl. 30: 254. 1769.

Cited by Rostafinski, Mon. 157. 1874, as a synonym of Didymium microcarpon.

Lycoperdon ungulinum Schum., Enum. Pl. Saell. 2: 192. 1803.

Cited by Rostafinski, Mon. 227. 1875, as a synonym of Enteridium olivaceum. Doubtful, according to G. Lister, Mycet. ed. 3. 193. 1925.

Lycoperdon verrucosum Batsch, Elench. Fung. 155. 1783.

Cited by Rostafinski, Mon. 286. 1875, as a synonym of Lycogala epidendrum, which the vague description makes possible.

Lycoperdon vesiculosum Batsch, Elench. Fung. Cont. 1: 253, f. 171. 1786.

Cited by Rostafinski, Mon. 254. 1875, as a synonym of *Trichia varia* var. *genuina*. Probably a *Trichia* but species uncertain.

Mucilago, filamentosa, ramosa. Bonamy, Fl. Nannat. Prod. 135, pl. 3. 1782.

Cited by Rostafinski, Mon. 191. 1874, as a synonym of Spumaria alba. Citation suggests not a binomial.

Mucor albus Sobolaw., Fl. Petrop. 324. 1799.

Cited by Rostafinski, Mon. 127. 1874, as a synonym of Tilmadoche nutans.

Mucor araneosus Jacq., Misc. Austr. 2: 376, pl. 20. 1781.

Incorrectly cited by Rostafinski, Mon. 194. 1874, as a synonym of Stemonitis fusca. Copied, with correction, by later authors. Extremely doubtful. The original description and figure suggest Tubifera ferruginosa.

Mucor carneus Schaeff., Fung. Bavar. 4: 133, pl. 195. 1774.

Fries, Syst. Myc. 3: Index 120. 1832, suggests Aethalium septicum, but that is extremely doubtful.

Mucor carnosus Dicks.

Cited by Rostafinski, Mon. 376, index, without citation, as a synonym of Fuligo varians. Reference evidently to Dickson, Pl. Crypt. Brit. 1785–1801, n.v.

Mucor embolus L. Sp. Pl. 1185, 1753.

Presumably an Arcyria or a Stemonitis. See Martin, 1966.

Mucor granulatus Schaeff., Fungi Bav. 4: 133, pl. 296. 1774.

Cited by Rostafinski, Mon. 254. 1875, as a synonym of *Trichia varia*. Highly questionable.

Mucor lacteus Leers. Fl. Herborn., No. 1132. 1775.

Cited by Rostafinski, Mon. 252. 1875, as a synonym of Trichia varia var. nigripes.

Mucor lycoperdoides Scop., Ann. Nat. Hist. 4: 151, pl. 1, f. 11. 1772.

Cited by Rostafinski, Mon. 294. 1875, as a synonym of *Perichaena fuscoatra*; by G. Lister, Mycet. ed. 3. 246. 1925, as a doubtful synonym of *P. corticalis*.

Mucor miniatus Jacq., Fl. Austr. 3: 54, pl. 299. 1775.

Cited by Rostafinski, Mon. 243. 1875, as a synonym of *Trichia fallax*. Doubtful, G. Lister, Mon. ed. 3. 212. 1925.

Mucor pyriformis Scop., Fl. Carn. ed. 2. 2: 492. 1772.

Cited by Rostafinski, Mon. 247. 1875, as a synonym of "Trichia nigripes;" 252, of T. varia var. nigripes. See G. Lister, Mycet. ed. 3. 208. 1925.

Mucor sphaerocephalus Batsch, Elench. Fung. 157. 1783.

Cited by Rostafinski, Mon. 154. 1874, as a synonym of *Didymium farinaceum*, but that is no more than a possibility.

"Mucor stemonitis Schaeff.," Fung. Bavar. 133. pl. 297. 1774.

Not published as new. Schaeffer cites M. stemonitis Scop. His plate does in all probability represent Comatricha typhoides.

Mucor stemonitis Scop., Fl. Carn. ed. 2. 2: 493. 1772.

Cited by Rostafinski, with preceding, as a synonym of Comatricha typhina, probably correctly.

Mucor tubulosus Retz., Sv. Vet.-Akad. Handl. 30. 1769.

Cited by Rostafinski, Mon. 220. 1875, as a synonym of Tubulina cylindrica. Fries,

Syst. Myc. 3: Index 121. 1832, wrote after it (*Licea*), since he then regarded *Tubulina* as a "tribus" of *Licea*.

Mucor violaceus Leers, F. Herborn., No. 1128. 1775.

Cited by Rostafinski, Mon. 204. 1874, as synonym of Lamproderma columbinum.

Oligonema aurantium Nann.-Brem., K. Ned. Akad. Wet. C. 71: 41, f. 1. 1968.

Differing from O. schweinitzii in the spores, which are orange in mass and bearing a fine reticulum, and in the crowded, but not superimposed sporangia.

"Oligonema nitens A. Lister" Mycet. ed. 2. 221. 1911.

Cited by G. Lister, l. c., as a synonym of O. flavidum. A. Lister in 1895 merely included forms now segregated as O. flavidum in O. nitens (Lib.) Rost.

"Ophiuridium rugulosum Hazsl., Bot. Jahresber. 5: 155. 1877."

Cited by Berlese, in Sacc., Syll. 7: 409. 1888, as a synonym of *Clathroptychium rugulosum*. No such name has been found either in reference cited, nor in Hazslinszski's original paper (1877), on which the notice in the Jahresbericht is based.

Paradiachea anglica B. Ing & Holland, Trans. Brit. Mycol. Soc. 50: 686. [1967] 1968. Distinguished from other species assigned to this genus by lack of columella.

Paradiacheopsis cribrata Nann.-Brem., K. Ned. Akad. Wet. C. 71: 47, f. 5. 1968.

With capillitium ramifying at tips beneath peridium, to form a *Cribraria*-like net. *Perichaena quercina* Fries, Symb. Gast. 12. 1817.

Cited by Rostafinski, Mon. 293. 1875, as a synonym of *P. corticalis*, "p.p." in index. Regarded as doubtful by G. Lister, Mon. ed. 2. 250. 1911. See also Fries, Syst. Myc. 3: 192. 1829, where he cites *Physarum luteoalbum* Schum. as a synonym.

Perichaena strobilina (Alb. & Schw.) Fries, Symb. Gast. 11. 1817.

Based on *Licea strobilina* Alb. & Schw., which was probably a rust. Fries, in Syst. Myc. 3: 191. 1829 cites Greville's plate 275, which supports this view.

Perichaena suberea (Chev.) Fries, Summa Veg. Scand. 459. 1848.

Based on Phelonitis suberea Chev., q.v.

Peziza convivalis Batsch, Elench. Fung. 121. 1781.

Cited by Rostafinski, Mon. 123. 1874, as a synonym of *Craterium leucocephalum*, "p.p." in index. Doubtful, G. Lister, Mycet. ed. 3. 78. 1925.

Phelonitis strobilina (Alb. & Schw.) Fries, Summa Veg. Scand. 459. 1849.

Based on Licea strobilina Alb. & Schw. Probably a rust.

Physarum anceps de By., in Fuckel, Jahrb. Nass. Ver. Nat. 23-24: 343. 1869.

Fuckel cites F. rhen. 1460, n.v., which may have included a description. Cited by Rostafinski, Mon. 103. 1874, as a synonym of *Physarum virescens*.

Physarum bubalinum Farr, Contr. U.S. Nat. Herb. 37: 412, f. 3-5. 1969.

Close to P. compressum.

Physarum cancellatum Wallr., Fl. Crypt. Germ. 2: 351. 1833.

Cited by Rostafinski, Mon. 140, 1874, as a synonym of *Badhamia hyalina*, "p.p." in index. Doubtful, G. Lister, Mycet. ed. 2. 31. 1911.

"Physarum citrinum Sacc.," Syll. Fung. n. 1176. 1888.

Cited by Massee, Mon. 275, as a synonym of P. schumacheri; 278, of P. melleum, in part. Berlese, in Sacc., Syll. 7: 340, wrote P. citrinum Schum.

"Physarum clavus Link," Ges. Nat. Freunde Berlin Mag. 3: 27. 1809.

Cited by Rostafinski, Mon. 135. 1874, as a synonym of *Didymium farinaceum* Schrad. Link wrote *D. clavus* Alb. & Schw.

Physarum compressum Skvortz., Philipp. Jour. Sci. 46: 86. 1931.

Differing from *P. compressum* Alb. & Schw., in the dark, yellow-brown nodes and yellow-brown stem. Described as new by Skvortzow, hence his name is a later homonym of that of Albertini and Schweinitz.

"Physarum confluens Fries," Syst. Myc. 3: 146. 1829.

Cited by Rostafinski, Mon. 164. 1874, as a synonym of *Didymium effusum* "Excl. syn.!" Fries published this as *Physarum confluens* Pers., Syn. Fung. 169. 1801, but on the same page Rostafinski cites Persoon's combination as a synonym of *Didymium confluens* (Pers.) Rost.

Physarum confluens Pers., Syn. Fung. 169. 1801.

See Fries, Syst. Myc. 3: 146. 1829. Probably includes several species.

Physarum confluens Spreng., Fl. Halensis, Mant. II. 29. 1811.

This may have been intended as a reference to P. confluens Pers., but Persoon is not cited, and the very brief diagnosis suggests that that may not be the case.

"Physarum licea Fuckel," Jahrb. Nass. Ver. Nat. 23-24: 342. 1870.

Cited by Rostafinski, Mon. 208. 1875, as a synonym of *Lamproderma fuckelianum*. Fuckel cited *P. licea* Fries. In correcting the reference (l.c. 27–28: 69. 1873), the specific epithet was spelled "*lycea*," an obvious error.

"Physarum macrocarpum Fuckel"

Cited by Rostafinski, Mon. 138. 1874 and copied by numerous authors since. Not validly published. Fuckel, Jahrb. Nass. Ver. Nat. 23–24: 343. 1870, wrote *P. macrocarpum* Ces.

Physarum muscicola Pers., Obs. Myc. 1: 6. 1796.

Recognized as distinct by Albertini & Schweinitz, Fries and Berlese (as *P. muscicolum*), in Sacc., Syll. 7: 351. 1888. Persoon's type, if still in existence, should be examined.

Physarum niezabitowskii A. Namysl., Spraw. Kom. Fizjogr. 72: 453. 1937. n.v.

Cited by Krzemieniewska, Sluz. 80. 1960, as a synonym of *P. cinereum*. "*Physarum pini* Fries"

Rostafinski, Mon. 383. 1875, in index. As noted in Mon. 128, this is *P. pini* Schum. as interpreted by Fries.

Physarum pyriforme Schum., Enum. Pl. Saell. 2. No. 1448. 1803.

Cited by Rostafinski, Mon. 244. 1875, as a synonym of *Trichia fallax*. Berlese, in Sacc., Syll. 7: 439. 1888, spells epithet *piriforme*.

"Physarum virescens Fuckel," Jahrb. Nass. Ver. Nat. 23-24: 343. 1870.

Cited by Rostafinski, Mon. 101. 1874, as a synonym of P. sulphureum. Fuckel cited Ditmar as author.

Pittocarpium flavum Link, Ges. Nat. Freunde Berlin Mag. 7: 41. 1815.

An aethalioid growth, possibly not a myxomycete. Both Nees, 1816, and Fries, 1829, regarded the genus and species as doubtful.

Polyschismium trevelyani Corda ex Rost., Mon. 182. 1874.

The genus was validly published by Corda, Ic. Fung. 5: 20. 1842, with the type indicated as *Leangium? trevelyani* Grev., Scot. Crypt. Fl. pl. 132. 1824, but the actual combination was not printed in Corda's work. It seems to have first been printed in the Rostafinski Monograph. The genus should have been cited as a synonym of *Diderma* and the species as a synonym of *D. trevelyani*.

"Reticularia maxima Corda," Ic. Fung. 6: 14, pl. 2, f. 35. 1854.

Cited by Rostafinski, Mon. 224. 1875, as a synonym of *Lindbladia effusa*. Corda cited Fries as author. Probably not *Brefeldia maxima* and surely not *Lindbladia*. Possibly *Reticularia lycoperdon*.

"Reticularia sphaeroides Gmel." in Rost., Mon. 387. 1875.

Probably an error for R. sphaeroidalis Bull. emend. Gmel., Syst. Nat. 1472. 1791.

Rostafinskia australis Speg., Ann. Soc. Ci. Arg. 10: 151. 1880.

Possibly, but not certainly, a myxomycete.

Sphaerocarpa operculata Schum., Enum. Pl. Saell. 2: 220. 1803.

Schumacher says "an Sph. turbinatus Bull. 484, f. 1?" q.v.

Sphaerocarpus turbinatus Bull., Hist. Champ. Fr. 132, pl. 484, f. 1. 1791.

Quite possibly Craterium minutum, as suggested by G. Lister, Mon. ed. 3. 75. 1925.

Spumaria alba Schum., Enum. Pl. Saell. 2: 195. 1803.

Not S. alba (Bull.) DC. 1805. Cited by Rostafinski, Mon. 175. 1874, as a synonym of Chondrioderma spumarioides.

Spumaria micheneri Berk., Grevillea 2: 52. 1873.

Identity uncertain. Berlese, in Sacc. Syll. 7: 389. 1888.

Stemonitis aequalis (Peck) Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 70: 206. 1967.
Basionym: Comatricha aequalis Peck. A later homonym of S. aequalis (Peck)
Massee.

Stemonitis antiades (Bull.) Gmel. Syst. Nat. 2: 1469. 1791.

Based on Sphaerocarpus antiades Bull., Hist. Champ. Fr. 127. 1791, pl. 368, f. 2. Certainly not a Stemonitis in current sense. A Physarum?

Stemonitis bombacina (Batsch) Gmel., Syst. Nat. 2: 1470. 1791.

Cited by Rostafinski, Mon. 247. 1875, as a synonym of Trichia fragilis.

Stemonitis carnea Trent., in Roth, Cat. Bot. 1: 222. 1797.

Cited by Rostafinski, Mon. 275. 1875, as a synonym of Arcyria incarnata, "p.p." in index. Doubtful, G. Lister, Mycet. ed. 3. 237. 1925.

"Stemonitis fasciculata DC.," Fl. Fr. 256. 1805.

Cited by Rostafinski, Mon. 196. 1874, as a synonym of S. ferruginea, and copied by later authors; de Candolle named Persoon as author.

"Stemonitis ferruginea Fries," Syst. Myc. 3: 158. 1829.

Cited by G. Lister, Mycet. ed. 3. 138. 1825, as a synonym, in part, of S. flavo-genita. Fries named Ehrenberg as author.

Stemonitis flavescens Schrank, Mag. Bot. Römer & Usteri 4(12): 20. 1790.

Cited by Rostafinski, Mon. 244. 1875, as a synonym of Trichia fallax, "p.p." in index

Stemonitis foliicola B. Ing, Trans. Brit. Mycol. Soc. 50: 555. [1967] 1968.

Formerly regarded as a phase of S. trechispora (Torr.) Macbr.

Stemonitis minor Golov., Fl. Miksam Kazak. 129. 1960.

Nomen nudum.

Stemonitis nigra Schum., Enum. Pl. Saell. 2: 217. 1803.

Probably not intended as new.

Stemonitis olivacea (Bolt.) Gmel., Syst. Nat. 2: 1468. 1791.

Based on Clathrus olivaceus Bolt., Hist. Fung. 3: 94. 178, pl. 94, II. 1789. Possibly a Didymium.

Stemonitis piriformis Auct.

See S. pyriformis. The specific epithet is copied both with i and y, for the various species included.

"Stemonitis pyriformis Roth," Fl. Germ. 1: 548. 1788.

Listed by Rostafinski, Mon. 255. 1875, as a synonym of *Trichia chrysosperma*. Roth gives author as Willdenow.

Stemonitis pyriformis Willd., Fl. Berol. Prod. 408. 1787.

Cited by Rostafinski, Mon. 252. 1875, as a synonym of Trichia varia.

Stemonitis reticulata Trent., in Roth, Cat. Bot. 1: 233. 1797.

Cited by Rostafinski, Mon. 199. 1874, as a doubtful synonym of Comatricha friesiana.

Stemonitis semitrichioides J. F. Gmel., Syst. Nat. 1468. 1791.

Apparently based on Sphaerocarpus semitrichioides Bull., Hist. Champ. Fr. 125, pl. 387, f. II, although Gmelin cites p. 124, pl. 387, f. I, which appears to be what is now called Dictydium cancellatum. Under his following species, S. cancellata, Gmelin reverses the references. S. semitrichioides is thus possibly a Trichia.

Stemonitis sophia Golov., Fl. Miksom. Kazak. 129. 1960.

Nomen nudum.

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Gmelin cites Wiggers No. 1153, which is Arcyria piriformis Wiggers, Prim. Fl. Holsat. 110. 1780.

Stemonitis turbinata (Bull.) J. F. Gmel., Syst. Nat. 1469. 1791.

Based on Sphaerocarpus turbinarus Bull., Hist. Champ. Fr. 130. 1791, pl. 417, f. I, which is probably Craterium minutum.

Stemonitis vitellina J. F. Gmel., Syst. Nat. 1470. 1791.

Gmelin cites Lycoperdon luteum Jacq., Misc. Austr. 139, pl. 8. 1777, which is apparently a hypocreaceous fungus.

"Strongylium atrum Link"

See S. atrum (Alb. & Schw.) Sw.

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Error for T. reticulata DC.

Trichia cinnabarina (Bull.) DC., Fl. Fr. 2: 255. 1805.

Based on Trichia cinnabaris Bull., Hist. Champ. Fr. 121. 1791, pl. 502, f. I. b, c. but with Bulliard's epithet cited as cinnabarina. T. cinnabaris Bull. and "T. cinnabaris DC." are both cited by Rostafinski, Mon. 269. 1875, as synonyms of Arcyria punicea, with the latter wrongly cited, while T. cinnabaris Bull., Hist. Champ. Fr. [121], pl. 502, f. I. d. 1791, is cited by Rostafinski on p. 275 as a synonym of Arcyria incarnata. All of Bulliard's eight figures on pl. 502, f. 1, a-h, surely represent what is now called Arcyria denudata.

Trichia coccinea (Bull.) DC., Fl. Fr. 2: 255. 1805.

Based on Sphaerocarpus coccineus Bull., Hist. Champ. Fr. 126. 1791, pl. 368, f. 1. Probably an Arcyria with persistent upper peridium. A later homonym of following.

Trichia coccinea Hoffm., Veg. Crypt. 2: 10, pl. 3, f. 1-2. 1790.

Identity doubtful. Possibly not a myxomycete.

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If published as new, a later homonym of preceding.

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Basionym: Trichia varia var. fimicola Marchal, Bull. Soc. R. Bot. Belg. 34: 133. 1895.

Trichia flavicoma (A. Lister) B. Ing, Trans. Brit. Mycol. Soc. 50: 558. [1967] 1968. Basionym: Trichia botrytis var. flavicoma A. Lister, Mycetozoa 172. 1894.

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Trichia punctulata Schw., Trans. Am. Phil. Soc. II. 4: 259. 1832.

The description suggests a Perichaena.

Trichia pyriformis (Bull.) DC., Fl. Fr. 2:251. 1805.

Based on Sphaerocarpus piriformis Bull., Hist. Champ. Fr. 129. 1791, pl. 417, f. II. Cited by Rostafinski, Mon. 252. 1875, as a synonym of Trichia varia. Highly improbable. G. Lister, Mycet. ed. 3. 212. 1925, suggests T. decipiens.

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Plates I-XLI

Plate I

- 1 Ceratiomyxa fruticulosa (Mill.) Macbr.
 - a Stalked sporophore, from large group, × 20
 - **b** Tip of branch, \times 100
 - c Spore, \times 1000
- 2 Ceratiomyxa morchella Welden
 - a Fructification, \times 15
 - **b** Spore, × 1000
- 3 Ceratiomyxa sphaerosperma Boedijn
 - a Fructification, \times 15
 - b Tip of branch, after Boedijn, × 100
 - c Spore, × 1000
- 4 Licea biforis Morgan
 - a Sporangium, × 5
 - b Cluster of three sporangia, × 50
 - c Spore, \times 1000
- 5 Licea castanea G. Lister
 - a Sporangium, × 5
 - **b** Cluster of sporangia, \times 20
 - c Open sporangium, × 40
 - d Sporangial lobes, \times 100
 - e/f Spores, \times 1000
- 6 Licea fimicola Dearn. & Bisby
 - a Cluster of sporangia, × 5
 - b Cluster of sporangia, × 50
 - c Spores, \times 1000
- 7 Licea kleistobolus Martin
 - a Sporangium, × 5
 - **b** Sporangium, \times 100
 - c Diagram of lid in section, × 300
 - d Spore, \times 1000
- 8 Licea minima Fries
 - a Sporangium, × 5
 - **b** Two sporangia, \times 40
 - c Spores, \times 1000

- 9 Licea operculata (Wingate) Martin
 - a Sporangium, × 10
 - **b** Two sporangia, \times 25
 - c Spore, \times 1000
- 10 Licea parasitica (Zukal) Martin
 - a Sporangium, × 5
 - **b** Sporangium, \times 50
 - c Spore, \times 1000
- 11 Licea pedicellata (H. C. Gilbert) H. C. Gilbert
 - a Sporangium, × 5
 - **b** Two sporangia, × 50
 - c Spore, \times 1000
- 12 Licea pusilla Schrad.
 - a Sporangium, × 5
 - **b** Two sporangia, \times 25
 - c Spore in optical section, \times 1000
 - d Spore from different fruiting, surface view, × 1000
- 13 Licea tenera Jahn
 - a Sporangium, × 5
 - **b** Sporangium, \times 50
 - c Spore, \times 1000
- 14 Licea tuberculata Martin
 - a Sporangium, × 5
 - **b** Sporangium, \times 50
 - Portion of wall, by transmitted light, flattened and showing plates, × 250
 - d Spore, \times 1000
- 15 Licea variabilis Schrad.
 - a Sporangia and plasmodiocarp formed by union of sporangia, \times 5
 - **b** Spore, \times 1000

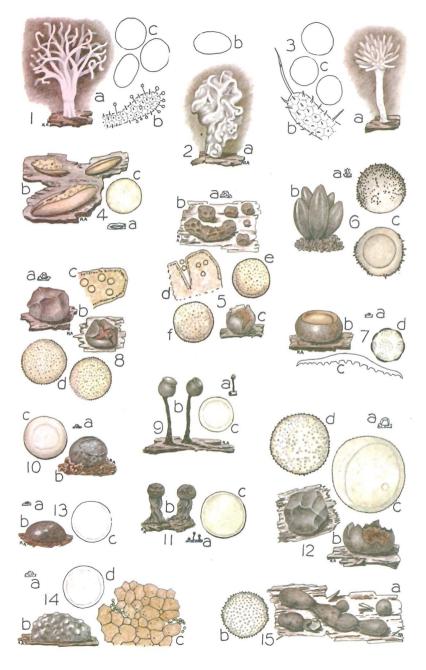


Plate II

- 16 Tubifera bombarda (Berk. & Br.) Martin
 - a Three sporangia on common stalk, × 10
 - b Detail of capillitium, showing attachment to stalk, × 25
 - c Enlarged thread of capillitium, × 500
 - d Spores, \times 1000
- 17 Tubifera casparyi (Rost.) Macbr.
 - a Pseudoaethalium, in section, × 5
 - **b** Columella with branches, \times 50
 - c Spores, × 1000
- 18 Tubifera ferruginosa (Batsch) J. F. Gmel.
 - a Pseudoaethalium, × 1
 - **b** Portion in section, \times 10
 - c Spores, \times 1000
- 19 Tubifera microsperma (Berk. & Curt.) Martin
 - a Pseudoaethalium, × 2
 - **b** Spores, \times 1000
- 20 Tubifera papillata Martin, Thind and Sohi
 - a Clustered sporangia on stalk, × 4
 - **b** Spores, \times 1000

- 21 Dictydiaethalium plumbeum (Schum.) Rost.
 - a Pseudoaethalium, × 1
 - **b** Detail, showing caps and threads, \times 20
 - c Detail of cap with attached threads, × 50
 - d Spore, $\times 1000$
- 22 Lycogala conicum Pers.
 - a Four aethalia, × 10
 - **b** Spores, \times 1000
- 23 Lycogala epidendrum (L.) Fries
 - a Cluster of aethalia, × 1
 - **b** Spores, \times 1000
 - c Thread of pseudocapillitium, × 100
- 24 Lycogala exiguum Morgan
 - a Cluster of aethalia, × 3
 - **b** Detail of peridium, × 200
 - c Spores, \times 1000
- 25 Lycogala flavofuscum (Ehrenb.) Rost.
 - a Pseudoaethalium, × 1/2
 - b Detail of pseudocapillitium, × 100
 - c Spores, \times 1000



Plate III

- 26 Reticularia intermedia Nann,-Brem.
 - a Aethalium, × 1
 - b Pseudocapillitium, × 2½
 - c Spore, \times 1000
- 27 Reticularia jurana Meylan
 - a Aethalium, × 1/2
 - b Pseudocapillitium, basal portion at left; outer portion at right, \times 50
 - c Spore, \times 1000
- 28 Reticularia lobata A. Lister
 - a Cluster of aethalia, ×2
 - b Portion of peridium with attached pseudocapillitium, $\times 50$
 - c Spore, \times 1000
- 29 Reticularia lycoperdon Bull.
 - a Aethalium, × 1/2
 - b Pseudocapillitium, × 3
 - c Spores, \times 1000
- 30 Reticularia olivacea (Ehrenb.) Fries
 - a Aethalium, $\times 2$
 - b Pseudocapillitium, × 75
 - c Cluster of spores, × 500
 - d Isolated spore, × 1000
- 31 Reticularia splendens Morgan
 - a Aethalium, $\times 1$
 - **b** Pseudocapillitium, \times 25
 - c Spore, \times 1000

- 32 Lindbladia tubulina Fries
 - a Pseudoaethalium, × 1/2
 - **b** Section through pseudoaethalium with sporangium superimposed, \times 5
 - c Group of massed sporangia, × 5
 - d Two isolated, stipitate sporangia, $\times 5$
 - e Spore, with dictydine granules, × 1000
- 33 Cribraria argillacea (Pers.) Pers.
 - a Sporangium, ×3
 - b Group of sporangia, × 5
 - c Sporangium, × 15
 - d Detail of surface net, with spores, × 100
 - e Spores, with dictydine granules, × 1000
- 34 Cribraria atrofusca Martin & Lovejoy
 - a Sporangium, ×3
 - b Same, \times 15
 - c Detail of cup and net, \times 50
 - d Spore and dictydine granules, × 1000
- 35 Cribraria dictyospora Martin & Lovejoy
 - a Sporangium, ×3
 - b Same, \times 15
 - c Spore and dictydine granule, × 1000
 - d Portion of surface net, with spores, \times 100
- 36 Cribraria elegans Berk. & Curt.
 - a Sporangium, ×3
 - **b** Same, \times 15
 - c Detail of net, with spores, \times 100
 - d Spore and dictydine granule, × 1000



Plate IV

37 Cribraria ferruginea Meylan

- a Sporangium, ×3
- **b** Same, \times 15
- c Detail of cup and net, with spores, × 100
- d Spore and dictydine granules, × 1000

38 Cribraria intricata Schrad.

- a Sporangium, ×3
- **b** Same, with rudimentary cup, \times 15
- c Same, with developed cup, \times 15
- d Detail of cup and net, with spores, \times 100
- e Node, $\times 250$
- f Spore and dictydine granules, × 1000

39 Cribraria languescens Rex

- a Sporangium, ×3
- **b/c** Three sporangia, \times 15
- d Margin of cup and net, with spores, \times 100
- e Node, with spore, \times 250
- f Spore and dictydine granules, × 1000

40 Cribraria laxa Hagelst.

- a Sporangium, × 3
- b Same, \times 15
- c Net, with spores, \times 100
- d Node, with spore, \times 250
- e Spore and dictydine granules, \times 1000

41 Cribraria lepida Meylan

- a Two sporangia, $\times 3$
- **b/c** Two sporangia, \times 10
- d Node, with spores, \times 250
- **e** Spore and dictydine granules, \times 1000

42 Cribraria macrocarpa Schrad.

- a Sporangium, $\times 3$
- **b** Same, \times 15
- **c** Detail of net, with spores, \times 100
- d Spore and dictydine granules, \times 1000

43 Cribraria microcarpa (Schrad.) Pers.

- a Two sporangia, × 3
- **b** Same, \times 15
- c Detail of net, with spores, \times 100
- d Node, with spores, \times 250
- e Spore and dictydine granules, \times 1000

44 Cribraria minutissima Schw.

- a Sporangium, ×3
- **b** Two sporangia, × 15
- c Net, with spores, \times 100
- d Detail of net, with spores, × 500
- e Spore and dictydine granules, \times 1000

45 Cribraria oregana H. C. Gilbert

- a Sporangia, ×3
- **b** Two sporangia, \times 15
- c Detail showing margin of cup and net, with spores, × 100
- d Spores and dictydine granules, × 1000

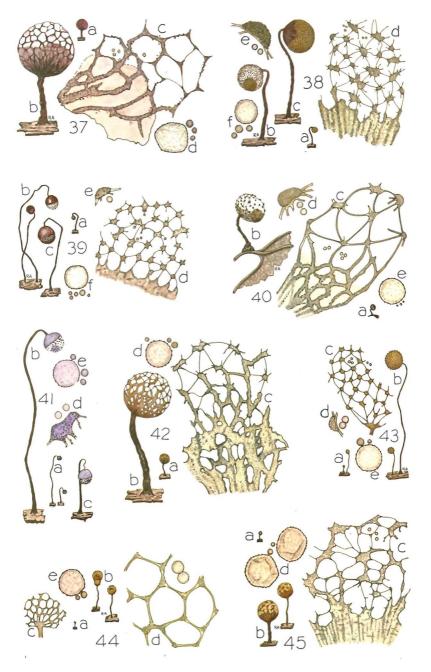


Plate V

- 46 Cribraria piriformis Schrad.
 - a Sporangium, ×3
 - b Two sporangia, the larger containing spores, \times 15
 - c Detail of net, $\times 100$
 - d Node, $\times 250$
 - e Spore and dictydine granules, × 1000
- 47 Cribraria purpurea Schrad.
 - a Sporangium, ×3
 - **b** Same, \times 15
 - c Detail of net, × 100
 - d Spore and dictydine granules, × 1000
- 48 Cribraria rubiginosa Fries
 - a Sporangium, ×3
 - b Same, \times 10
 - c Detail of net, × 100
 - d Spore and dictydine granules, \times 1000
- 49 Cribraria rufa (Roth) Rost.
 - a Two sporangia, × 3
 - b Same, \times 15
 - c Detail of net, × 100
 - d Spore and dictydine granule, \times 1000
- 50 Cribraria splendens (Schrad.) Pers.
 - a Two sporangia, × 3
 - b Same, \times 15
 - c Apex of stipe and net, × 100
 - d Spore and dictydine granules, × 1000

- 51 Cribraria tenella Schrad.
 - a Two sporangia, ×3
 - b Three sporangia, showing variation in stalks and cups, × 10
 - c Margin of cup with net attached, and portion of net from another sporangium, × 100
 - d Node, $\times 250$
 - e Spore and dictydine granules, × 1000
- 52 Cribraria violacea Rex
 - a Two sporangia, showing variation in size, $\times 3$
 - **b** Sporangium, \times 25
 - c Sporangium, × 100
 - d Spore and dictydine granules, × 1000
- 53 Cribraria aurantiaca Schrad.
 - a Sporangium, ×3
 - **b** Two sporangia, \times 15
 - c Margin of cup and net, × 100
 - d Node, $\times 250$
 - e Spore and dictydine granules, × 1000

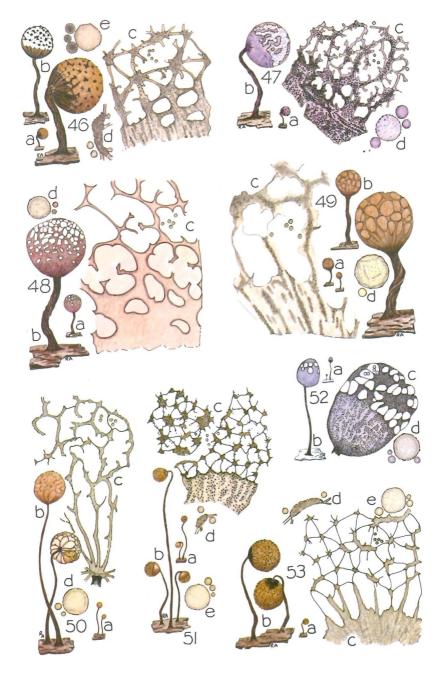


Plate VI

- 54 Dictydium cancellatum (Batsch) Macbr.
 - a Sporangium, × 20
 - **b** Same, without cup, \times 40
 - c Same, with cup, \times 40
 - **d** Same, with cribrarioid net above, \times 40
 - e Detail of net, $\times 250$
 - f Spore and dictydine granules, × 1000
- 55 Dictydium mirabile (Rost.) Meylan
 - a Sporangium, × 20
 - b Spore and dictydine granule, × 1000
- 56 Dictydium rutilum G. Lister
 - a Two sporangia, \times 20
 - **b** Spore and dictydine granules, \times 1000
- 57 Echinostelium cribrarioides Alexop.
 - a Sporangium with net only, $\times 100$
 - **b** Spore, × 1000
- 58 Echinostelium elachiston Alexop.
 - a Sporangium with spores clustered at tip of stalk, × 100
 - **b** Spore, \times 1000
- 59 Echinostelium fragile Nann.-Brem.
 - a Stalk with basal disk and columella, × 200
 - **b** Tip of same, enlarged, \times 500
 - c Spore, \times 1000
- 60 Echinostelium minutum de Bary
 - a Sporangium with spores clustered at tip, $\times 100$
 - **b** Capillitium, \times 250
 - c Spore, \times 1000
- 61 Listerella paradoxa Jahn
 - a Cluster of sporangia, \times 10
 - **b** Two sporangia, \times 50
 - c Capillitium, peridial lobe and spores, × 500
 - d Spore, \times 1000

- 62 Calomyxa metallica (Berk.) Nieuwl.
 - a Cluster of fructifications, \times 10
 - **b** Detail of capillitium, and spores, × 500
 - c Spore, \times 1000
- 63 Dianema corticatum A. Lister
 - a Sporangium and plasmodiocarp, × 10
 - b Detail of capillitium, and spores, × 500
 - c Spore, \times 1000
- 64 Dianema depressa (A. Lister) A. Lister
 - a Sporangia and plasmodiocarp, $\times 5$
 - b Section through plasmodiocarp, × 5
 - c Detail of capillitium, and spores, × 500
 - d Spore, \times 1000
- 65 Dianema harveyi Rex
 - a Sporangia and plasmodiocarp, $\times 5$
 - b Detail of capillitium, showing attachment to peridium, and spores, × 500
 - c Spore, \times 1000
- 66 Prototrichia metallica (Berk.) Massee
 - a Sporangium, $\times 10$
 - **b** Small stalked sporagium, \times 10
 - c Detail of capillitium, and spores, × 500
 - d Spore, $\times 1000$

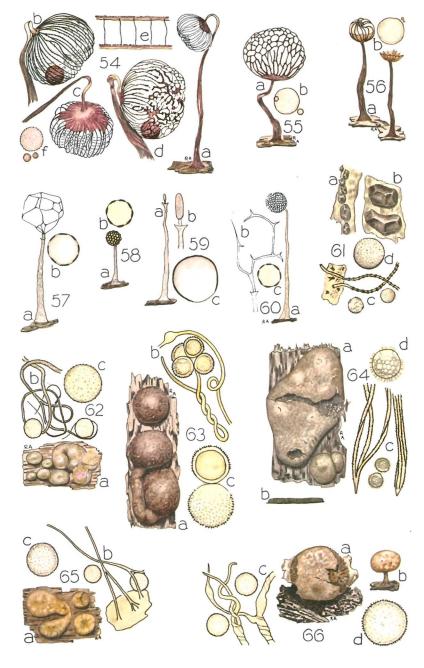


Plate VII

- 67 Perichaena chrysosperma (Currey) A. Lister
 - a Cluster of fructifications showing variation,
 × 3
 - **b** Semistipitate sporangium, × 10
 - c Detail of long-spined capillitium, and spore, × 500
 - d Detail of short-spined capillitium, \times 500
 - e Spore, \times 1000
- 68 Perichaena corticalis (Batsch) Rost.
 - a Cluster of sporangia, × 20
 - **b** Detail of capillitium, and spores, × 500
 - c Spore, $\times 1000$
- 69 Perichaena depressa Libert
 - a Cluster of sporangia, × 5
 - b Single sporangium with lid raised by expanding spore-mass, × 20
 - c Detail of capillitium, and spores, × 500
 - d Spore, \times 1000
- 70 Perichaena microspora Penzig & G. Lister
 - a Plasmodiocarp, × 5
 - b Detail of torulose capillitium and spores, × 500
 - c Detail of spiny capillitium, and spores, \times 500
 - d Spore, \times 1000
- 71 Perichaena minor (G. Lister) Hagelst.
 - a Three sporangia, $\times 5$
 - **b** Sporangium, \times 30
 - c Detail of capillitium, and spores, × 500
 - d Spore, \times 1000

- 72 Perichaena syncarpon T. E. Brooks
 - a Cluster of sporangia, $\times 10$
 - b Plasmodiocarp, × 20
 - Detail of capillitium and cluster of spores, × 500
 - d Isolated spore, \times 1000
- 73 Perichaena vermicularis (Schw.) Rost.
 - a Plasmodiocarp, \times 5
 - b Detail of capillitium attached to fragment of peridium, and spores, × 500
 - **c** Spore, × 1000
- 74 Oligonema flavidum (Peck) Peck
 - a Cluster of sporangia, × 4
 - **b** Same, \times 10
 - c Capillitial threads, and spore, \times 500
 - d Spore, \times 1000
- 75 Oligonema fulvum Morgan
 - a Two sporangia, × 20
 - **b** Capillitial thread, and spores, × 500
 - c Spore in optical section, \times 1000
- 76 Oligonema schweinitzii (Berk.) Martin
 - a Heap of sporangia, $\times 5$
 - **b** Portion of same, \times 20
 - c Capillitial thread, and spores, \times 500
 - d Spore, \times 1000

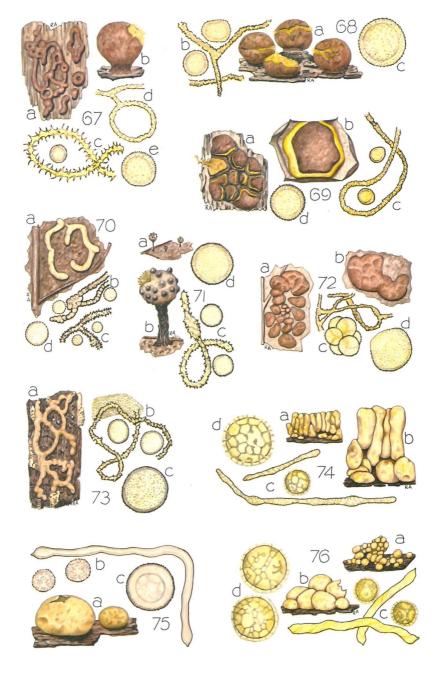


Plate VIII

77 Calonema aureum Morgan

- a Cluster of sporangia, × 5
- **b** Portion of same, \times 20
- c Detail of capillitium, and spores, \times 500
- d Spore, \times 1000

78 Arcyria annulifera Torrend

- a Sporangium, × 10 (in center)
- **b** Same, \times 20
- c Detail of capillitium, and spores, × 500
- d Spore, $\times 1000$

79 Arcyria carnea (G. Lister) G. Lister

- a Two sporangia and cup of a third, × 10
- **b** Detail of capillitium, and spores, × 500
- c Spore, $\times 1000$

80 Arcyria cinerea (Bull.) Pers.

- a Cluster of digitate gray sporangia, × 10
- b Single isolated ochraceous sporangium, \times 10
- c Four small sporangia, to illustrate variation in size and color, \times 10
- d Detail of capillitium, and spores, \times 500
- e Smoother and stouter basal capillitium, × 500
- f Spore, \times 1000

81 Arcyria corymbosa Farr & Martin

- a Cluster of sporangia, × 10
- **b** Detail of capillitium, and spores, × 500
- c Spore, $\times 1000$

82 Arcyria denudata (L.) Wettst.

- a Sporangium, \times 10
- **b** Detail of capillitium, and spores, × 500
- c Spore, \times 1000

83 Arcyria ferruginea Sauter

- a Two sporangia, one with capillitium detached, \times 10
- **b** Detail of capillitium, and spores, × 500
- c Spore, \times 1000

84 Arcyria glauca A. Lister

- a Sporangium, × 10
- b Detail of capillitium, and spores, × 500
- c Spore, $\times 1000$

85 Arcyria globosa Schw.

- a Three sporangia on spine of chestnut bur, \times 10
- **b** Detail of capillitium, and spores, × 500
- c Spore, \times 1000

86 Arcyria incarnata (Pers.) Pers.

- a Group of sporangia, × 2
- **b** Sporangium, with empty cups, × 10
- c Detail of capillitium, and spores, \times 500
- d Spore, $\times 1000$



Plate IX

- 87 Arcyria insignis Kalchbr. & Cooke
 - a Two sporangia, × 10
 - **b** Detail of capillitium, and spores, × 500
 - c Spore, \times 1000
- 88 Arcyria leiocarpa (Cooke) Martin & Alexop.
 - a Two sporangia, × 10
 - b Detail of capillitium and spores, × 500
 - c Spore, $\times 1000$
- 89 Arcyria magna Rex
 - a Cluster of sporangia, × 2
 - b Base of sporangium, with three empty cups $\times 10$
 - c Detail of capillitium, and spores, × 500
 - d Spore, $\times 1000$
- 90 Arcyria nutans (Bull.) Grev.
 - a Sporangium, $\times 2$
 - **b** Same, with two empty cups, \times 10
 - ${f c}$ Detail of capillitium, and spores, imes 500
 - d Spore, $\times 1000$
- 91 Arcyria occidentalis (Macbr.) G. Lister
 - a Cluster of sporangia, \times 10
 - **b** Two sporangia, \times 20
 - c Detail of capillitium, and spores, × 500
 - d Spore, \times 1000
- 92 Arcyria oerstedtii Rost.
 - a Sporangium, $\times 2$
 - **b** Base of sporangium, \times 10
 - c Detail of capillitium, and spores, × 500
 - d Spore, \times 1000

- 93 Arcyria pomiformis (Leers) Rost.
 - a Sporangium, \times 10
 - **b** Same, \times 20
 - c Detail of capillitium, and spores, × 500
 - d Spore, \times 1000
- 94 Arcyria stipata (Schw.) G. Lister
 - a Cluster of sporangia, $\times 5$
 - b Sporangium, × 5
 - c Isolated sporangium, \times 10
 - **d** Detail of capillitium, and spores, \times 500
 - e Spore, \times 1000
- 95 Arcyria versicolor Phill.
 - a Two sporangia, at left, capillitium beginning emergence, at right, completely emergent, but still compressed below, × 10
 - **b** Detail of capillitium, and spores, × 500
 - c Spore, \times 1000
- 96 Arcyria virescens G. Lister
 - a Sporangium, with empty cup, \times 10
 - **b** Detail of capillitium, and spores, × 500
 - c Spore, $\times 1000$
- 97 Arcyodes incarnata (Alb. & Schw.) O. F. Cook
 - a Cluster of sporangia, $\times 5$
 - **b** Portion of cluster, \times 20
 - c Detail of capillitium showing attachment to peridium, and spores, × 500
 - d Spore, \times 1000

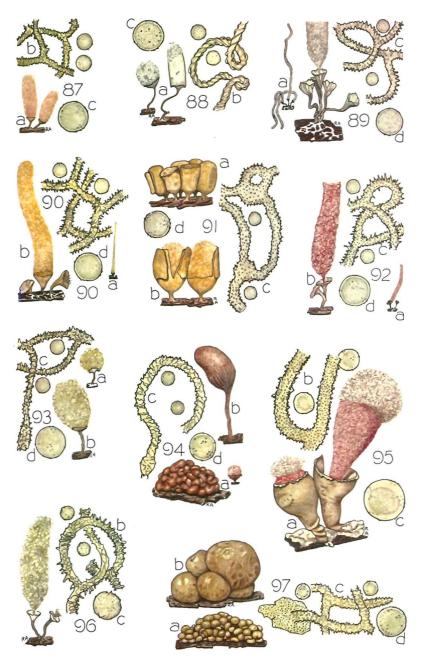


Plate X

- 98 Cornuvia serpula (Wigand) Rost.
 - a Cluster of fructifications, × 10
 - **b** Plasmodiocarp, \times 20
 - c Detail of capillitium, and spores, × 500
 - d Spore, $\times 1000$
- 99 Trichia alpina (R. E. Fries) Meylan
 - a Cluster of fructifications. × 10
 - b Tips of elaters, and spores, × 500
 - c Spore, \times 1000
- 100 Trichia botrytis (J. F. Gmel.) Pers.
 - a Cluster of sporangia, × 10
 - **b** Elater and spores, \times 500
 - c Spore, $\times 1000$
- 101 Trichia contorta (Ditmar) Rost.
 - a Cluster of fructifications, × 10
 - **b** Tips of elaters and spores, \times 500
 - c Spore, \times 1000

- 102 Trichia crateriformis Martin
 - a Two sporangia, × 5
 - **b** Sporangium, × 10
 - c Elater and spores, × 500
 - d Spore, $\times 1000$

103 Trichia erecta Rex

- a Sporangium, × 20
- b Tips of elaters and spores, × 500
- c Spore, × 1000
- 104 Trichia favoginea (Batsch) Pers.
 - a Two clusters of sporangia, × 5
 - b Two sporangia from group, × 20
 - c Tips of elaters and spores, ×500
 - d Spore, \times 1000
- 105 Trichia floriformis (Schw.) G. Lister
 - a Sporangia, × 10
 - **b** Elater and spores, \times 500
 - c Spore, $\times 1000$



Plate XI

- 106 Trichia lutescens (A. Lister) A. Lister
 - a Three sporangia, \times 10
 - **b** Tips of elaters and spores, × 500
 - c Spore, \times 1000
- 107 Trichia macbridei M. E. Peck
 - a Cluster of sporangia, × 5
 - **b** Pulvinate sporangium, \times 10
 - c Elater and spores, × 500
 - d Spore, $\times 1000$
- 108 Trichia decipiens (Pers.) Macbride
 - a Three sporangia, × 10
 - **b** Elater and spores, \times 500
 - c Spore, $\times 1000$
- 109 Trichia scabra Rost.
 - a Cluster of sporangia, × 5
 - **b** Three sporangia, \times 10
 - c Elater and spores, × 500
 - d Spore, $\times 1000$

- 110 Trichia subfusca Rex
 - a Four sporangia, on three stalks, ×10
 - **b** Sporangium, \times 20
 - c Tips of elaters and spores, × 500
 - d Spore, \times 1000
- 111 Trichia varia (Pers.) Pers.
 - a Cluster of sporangia, × 5
 - b Stalked sporangium, × 20
 - c Tips of elaters and spores, × 500
 - d Spore, \times 1000
- 112 Trichia verrucosa Berk.
 - a Cluster of sporangia on united stalks, imes 10
 - **b** Tips of elaters and spores, \times 500
 - c Spore, \times 1000
- 113 Hemitrichia abietina (Wigand) G. Lister
 - a Five sporangia, × 10
 - **b** Sporangium, \times 20
 - c Free tip of capillitium and spores, × 500
 - d Spore, × 1000

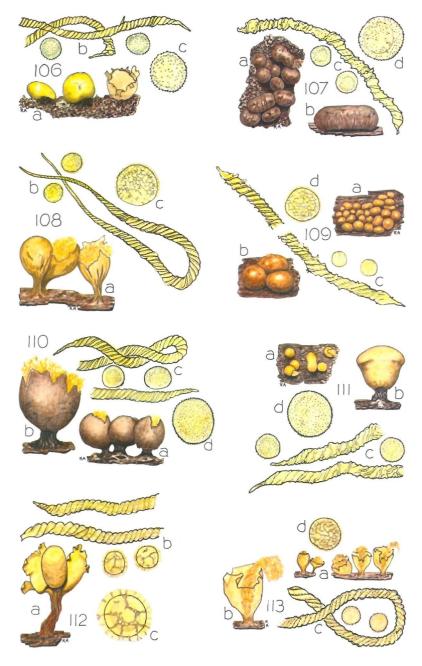


Plate XII

- 114 Hemitrichia clavata (Pers.) Rost.
 - a Three sporangia, \times 10
 - b Detail of capillitium, and spore, × 500
 - c Spore, $\times 1000$
- 115 Hemitrichia intorta (A. Lister) A. Lister
 - a Cluster of sessile sporangia, × 10
 - **b** Two sporangia, \times 25
 - c Detail of capillitium, and spores, × 500
 - d Spore, $\times 1000$
- 116 Hemitrichia karstenii (Rost.) A. Lister
 - a Cluster of fructifications, × 10
 - b Details of capillitium, and spores, × 500
 - c Spore, $\times 1000$
- 117 Hemitrichia montana (Morgan) Macbr.
 - a/b Two sporangia, × 10
 - Detail of capillitium including free tip, and spores, × 500
 - d Spore, \times 1000

- 118 Hemitrichia paragoga Farr
 - a Two sporangia, \times 20
 - **b** Detail of capillitium, and spores, × 500
 - c Spore, \times 1000
- 119 Hemitrichia serpula (Scop.) Rost.
 - a Plasmodiocarp, \times 10
 - b Detail of capillitium, and spores, × 500
 - c Spore, $\times 1000$
- 120 Hemitrichia stipitata (Massee) Macbr.
 - a Sporangium, × 10
 - b Detail of capillitium, and spores, × 500
 - c Spore, \times 1000
- 121 Metatrichia vesparium (Batsch) Nann.-Brem.
 - a Two free sporangia, × 10
 - **b** Group of sporangia clustered on united stalks, \times 10
 - c Group of empty sporangia on united stalks, \times 10
 - d Detail of capillitium, and spores, × 500
 - e Spore, $\times 1000$

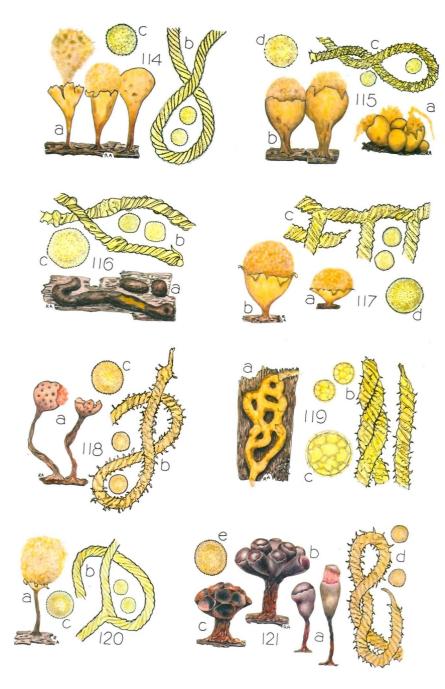


Plate XIII

- 122 Colloderma oculatum (Lippert) G. Lister
 - a Sporangium, dry, $\times 20$
 - b Sporangium, wet, showing gelatinous outer wall, × 20
 - c Small sporangium, ×20, showing inner layer of peridium
 - d Detail of capillitium, and spores, × 500
 - e Spore, \times 1000
- 123 Colloderma robustum Meylan
 - a Spore, \times 1000
- 124 Brefeldia maxima (Fries) Rost.
 - a Small aethalium, $\times 1$
 - **b** Vesicle and spores, $\times 500$
 - c Spore, $\times 1000$
- 125 Amaurochaete comata G. Lister & Brândză
 - a Capillitium and spores, \times 100
 - b Detail of capillitium, and spore, × 500
 - c Spore, \times 1000
- 126 Amaurochaete ferruginea Macbr. & Martin
 - a Stalk-like branch, from base, × 100
 - **b** Tip of same, and spores, \times 500
 - c Spore, \times 1000

- 127 Amaurochaete atra (Alb. & Schw.) Rost.
 - a Two small aethalia, $\times 1$
 - b Stalk from base giving rise to capillitium, $\times 10$
 - c Detail of capillitium, and spores, × 500
 - d Spore, $\times 1000$
- 128 Amaurochaete trechispora Macbr. & Martin
 - a Capillitium and spores, × 500
 - **b** Spore, \times 1000
- 129 Amaurochaete tubulina (Alb. & Schw.) Macbr.
 - a Capillitium and spores, × 500
 - **b** Spore, \times 1000
- 130 Elaeomyxa cerifera (G. Lister) Hagelst.
 - a Two sporangia, × 15
 - b Capillitium and spores, × 500
 - c Spore, $\times 1000$
- 131 Elaeomyxa miyazakiensis (Emoto) Hagelst.
 - a Two sporangia, \times 15
 - **b** Capillitium and spores, \times 500
 - c Spore, \times 1000



Plate XIV

- 132 Diachea bulbillosa (Berk. & Br.) A. Lister
 - a Two sporangia, × 20
 - b Detail of capillitium, and spores, × 500
 - c Lime crystals from interior of stalk, × 500
 - d Spore, $\times 1000$
- 133 Diachea leucopodia (Bull.) Rost.
 - a Two sporangia, \times 20
 - b Tip of columella surrounded by capillitium, × 50
 - c Detail of capillitium, and spores, × 500
 - d Spore, $\times 1000$
- 134 Diachea radiata G. Lister & Petch
 - a Long-stalked sporangium, × 20
 - b Short-stalked sporangium, × 20
 - c Detail of capillitium, with lime crystals from stalk, and spores, × 500
 - d Spore, $\times 1000$

- 135 Diachea splendens Peck
 - a Sporangium, $\times 20$
 - **b** Detail of capillitium, and spores, × 500
 - c Spore, $\times 1000$
- 136 Diachea subsessilis Peck
 - a Long-stalked sporangium, × 20
 - b Short-stalked and sessile sporangia, × 20
 - c Detail of capillitium, with spore, and lime crystal from stalk, × 500
 - d Spore, \times 1000
- 137 Diachea thomasii Rex
 - a Two sporangia, \times 20
 - **b** Detail of capillitium, and spores, × 500
 - c/d Spore, $\times 1000$
- 138 Schenella microspora Martin
 - a Detail of capillitium, and spores, \times 500
 - **b** Spore, \times 1000
- 139 Schenella simplex Macbride
 - a Pseudoaethalium, × ½
 - b Diagrammatic longitudinal section, showing sporangia attached to base and cortex, × 3 (a and b after Macbride)
 - c Cap and base of sporangium, × 20
 - d Detail of capillitium, and spores, × 500
 - e Spore, $\times 1000$

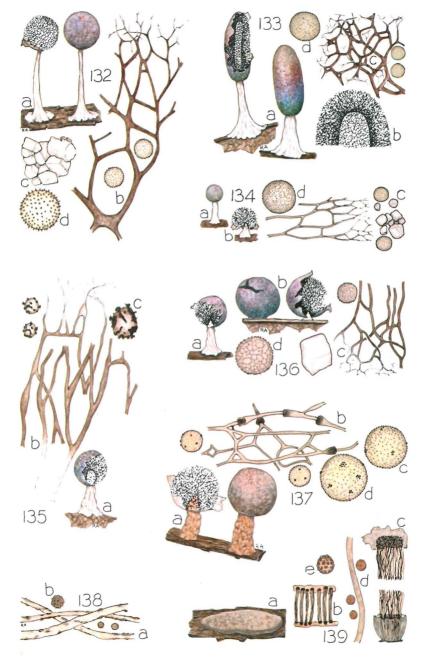


Plate XV

- 140 Enerthenema berkeleyanum Rost.
 - a Sporangium, spores shed, $\times 20$
 - **b** Tip of same, showing apical cup, \times 250
 - c Two spore clusters, \times 500
 - d Spore cluster, \times 1000
 - e Isolated spore, × 1000
- 141 Enerthenema melanospermum Macbr. & Martin
 - a Sporangium, spores shed, × 20
 - **b** Detail of capillitium, and spores, × 500
 - c Spore, $\times 1000$
- 142 Enerthenema papillatum (Pers.) Rost.
 - a Sporangium, × 10
 - **b** Same, spores shed, $\times 20$
 - c Tips of capillitium, and spores, × 500
 - d Spore, \times 1000

- 143 Stemonitis axifera (Bull.) Macbride
 - a Cluster of sporangia, × 2
 - **b** Detail of capillitium, with spores, $\times 500$
 - c Spore, \times 1000
- 144 Stemonitis confluens Cooke & Ellis
 - a Part of cluster of sporangia, × 2
 - b Group of united sporangia, × 10
 - c Detail of capillitium, with spores and membrane, × 250
 - d Detail of capillitium, with spores, \times 500
 - e Spore, \times 1000
- 145 Stemonitis flavogenita Jahn
 - a Two sporangia, $\times 2$
 - b Sporangium, ×5
 - c Tip of sporangium, × 25
 - d Detail of surface net, and spores, × 500
 - e Spore, \times 1000
- 146 Stemonitis fusca Roth
 - a Two sporangia, to show range in size, $\times 2$
 - **b** Part of a tuft of sporangia, $\times 2$
 - c Detail of capillitium, with surface net, and spores, × 500
 - d Spore, \times 1000

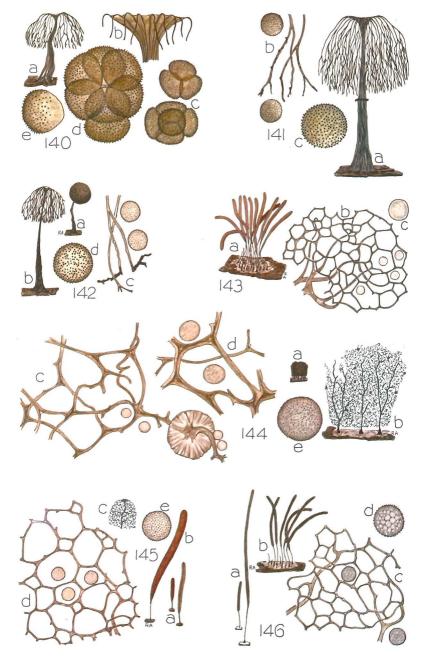


Plate XVI

147 Stemonitis herbatica Peck

- a Two sporangia, $\times 2$
- **b** Base and upper portion of sporangium, \times 25
- c Detail of surface net, with spores, \times 500
- d Spore, \times 1000

148 Stemonitis hyperopta Meylan

- a Four sporangia, × 2
- **b** Sporangium, \times 10
- c Detail of surface net, and spores, $\times 500$
- d Spore, \times 1000

149 Stemonitis mussooriensis Martin, Thind & Sohi

- a Sporangium, $\times 2$
- b Same, \times 10
- c Detail of surface net, with spores, $\times 500$
- d Spore, \times 1000

150 Stemonitis nigrescens Rex

- a Three sporangia, × 2
- **b** Sporangium, \times 10
- c Detail of surface net, with spores, $\times 500$
- d Spore, \times 1000

151 Stemonitis pallida Wingate

- a Part of a cluster of sporangia and an isolated sporangium, to show range in size, \times 2
- **b** Base and upper portion of sporangium, \times 25
- c Detail of surface net, and spores, × 500
- d Spore, $\times 1000$

152 Stemonitis smithii Macbr.

- a Sporangia, $\times 2$
- b Same, $\times 10$
- c Detail of surface net, and spores, × 500
- d Spore, $\times 1000$

153 Stemonitis splendens Rost.

- a Tuft of short sporangia, × 2
- b Same, of large sporangia, × 2
- c Detail of surface net, with spores, × 500
- d Spore, \times 1000

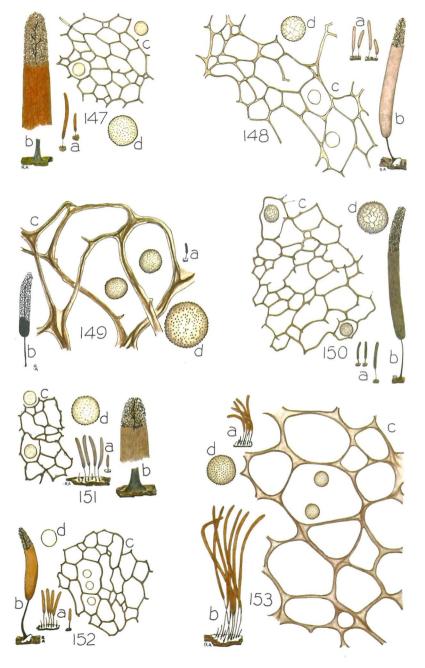


Plate XVII

154 Stemonitis trechispora (Berk.) Macbr.

- a Two sporangia, $\times 2$
- **b** Sporangium, × 10
- c Detail of surface net, and spores, × 500
- d Spore, \times 1000

155 Stemonitis uvifera Macbr.

- a Group of sporangia, × 2
- **b** Detail of surface net, and spores, \times 500
- c Cluster of spores, × 1000

156 Stemonitis virginiensis Rex

- a Two sporangia, × 2
- **b** Sporangium from type, $\times 2$
- c Same, \times 10
- d Detail of surface net, and spores, $\times 500$
- e Spore, $\times 1000$

157 Comatricha acanthodes Alexop.

- a Sporangium, × 5
- **b** Same, spores fallen, \times 50
- c Spore, \times 1000

158 Comatricha aequalis Peck

- a Three sporangia, × 5
- b Detail of capillitium, and spores, × 500
- c Spore, $\times 1000$

159 Comatricha aggregata Farr

- a Cluster of sporangia, × 5
- **b** Portion of same, lateral view, \times 10
- c Isolated sporangium, × 20
- d Columella, showing enlarged tip, and attached capillitial threads and peridial fragments, × 50
- e Two spores, \times 500
- f Spore, \times 1000

160 Comatricha caespitosa Sturgis

- a Tuft of sporangia, × 5
- **b** Sporangium, \times 20
- c Spore, $\times 1000$

161 Macbrideola decapillata H. C. Gilbert

- a Three sporangia, $\times 5$
- b Sporangium, spores fallen, × 50
- c Spore, × 1000. At the time this was drawn, it was believed to be Comatricha cornea G. Lister. See discussion under Macbrideola.

162 Comatricha cylindrica (Bilgram) Macbr.

- a Two sporangia, × 5
- **b** Sporangium, \times 20
- c Spore, $\times 1000$

163 Comatricha elegans (Racib.) G. Lister

- a Three sporangia, $\times 5$
- b Blown sporangium, showing tip of stalk and characteristic branching leading to capillitium, × 50
- c Detail of capillitium, and spores, × 500
- d Spore, $\times 1000$

164 Comatricha fimbriata G. Lister & Cran

- a Three sporangia, $\times 5$
- **b** Sporangium, spores shed, \times 50
- c Spore, × 1000

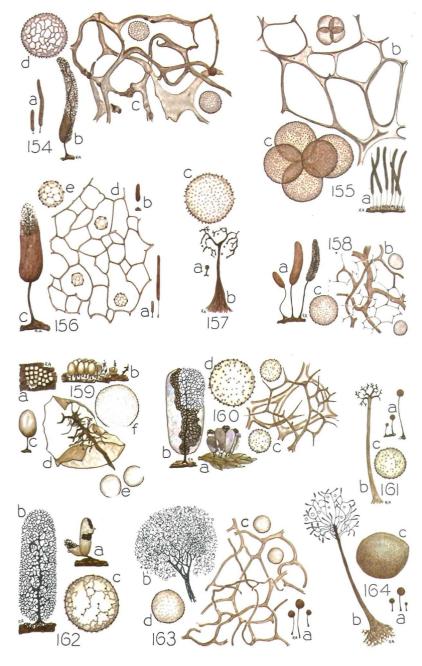


Plate XVIII

165 Comatricha irregularis Rex

- a Three sporangia, showing range in size × 5
- b Median portion of sporangium, showing columella and capillitium, × 50
- c Detail of capillitium, and spores, × 500
- d Spore, \times 1000

166 Comatricha laxa Rost.

- a Five sporangia, × 5
- **b** Sporangium, spores shed, $\times 20$
- c Details of capillitium, and spores, × 500
- d Spore, \times 1000

167 Comatricha longa Peck

- a Groups of sporangia from large fruitings,
- **b** Section of sporangium, showing columella and capillitium, $\times 50$
- c Detail of capillitium, and spores, × 250
- d Spore, \times 1000

168 Comatricha longipila Nann.-Brem.

- a Three sporangia, $\times 5$
- **b** Sporangium, \times 20
- c Detail of outer portion of capillitium, with spores, × 500
- d Spore, \times 1000

169 Comatricha lurida A. Lister

- a Four sporangia, × 5
- **b** Sporangium, showing stalk and capillitium, spores shed, \times 50
- c Outer portion of capillitium, with spores, × 500
- d Spore, \times 1000

170 Macbrideola martinii (Alexop. & Beneke) Alexop.

- a Two sporangia, \times 5
- **b** Sporangium, showing stalk and capillitium, spores shed, \times 50
- c Spore, \times 1000

171 Comatricha mirabilis Benj. & Poit.

- a Three sporangia, \times 5
- b Sporangium, showing stalk and capillitium, × 20
- c Tips of capillitium and spores, × 250
- d Spore, \times 1000

172 Comatricha nigra (Pers.) Schroet.

- a Three sporangia, × 5
- b Sporangium, spores shed, × 20
- c Capillitium and spores, × 500
- d Spore, \times 1000

173 Comatricha pulchella (C. Bab.) Rost.

- a Three sporangia, × 5
- **b** Sporangium, spores shed, \times 20
- c Capillitium at margin, and spores, × 500
- **d** Spore, × 1000



Plate XIX

174 Comatricha dictyospora Čelak.

- a Three sporangia, × 5
- **b** Sporangium, \times 10
- c Detail of capillitium, and spores, × 500
- d Spore, × 1000. Drawn from type of C. reticulata H. C. Gilbert

175 Comatricha rispaudii Hagelst.

- a Tuft of sporangia, × 5
- b Sporangium, showing persistent peridium at base, × 20
- c Detail of capillitium, and spores, × 500
- d Spore, $\times 1000$

176 Comatricha rubens A. Lister

- a Three sporangia, × 5
- b Sporangium, × 20
- c Tips of capillitium, and spores, × 500
- d Spore, \times 1000

177 Comatricha subcaespitosa Peck

- a Three sporangia, × 5
- **b** Sporangium, \times 20
- c Margin of capillitium, and spores, × 500
- d Spore, \times 1000

178 Comatricha suksdorfii Ell. & Ev.

- a Three sporangia, × 5
- **b** Detail of capillitium, and spores, × 500
- c Spore, \times 1000

179 Macbrideola synsporos (Alexop.) Alexop.

- a Two sporangia, × 5
- **b** Sporangium, with spore clusters, as seen in mounted specimen, \times 100
- c Cluster of spores, $\times 500$
- d Isolated spore, × 1000

180 Comatricha tenerrima (M. A. Curt.) G. Lister

- a Three sporangia, × 5
- b Sporangium, × 10
- c Detail of capillitium, and spores, × 500
- d Spore, $\times 1000$

181 Comatricha typhoides (Bull.) Rost.

- a Three sporangia, × 5
- b Sporangium, × 10
- c Detail of capillitium, and spores, × 500
- d Spore, $\times 1000$



Plate XX

182 Macbrideola decapillata H. C. Gilbert

- a Two sporangia, × 30
- **b** Sporangium bearing spores, × 150
- c Same, showing columella, \times 150
- d Spore, \times 1000

183 Machrideola scintillans H. C. Gilbert

- a Two sporangia, × 30
- b Sporangium, showing capillitium, spores and persistent peridium, × 150
- c Spore, $\times 1000$

184 Clastoderma debaryanum Blytt

- a Three sporangia, × 5
- **b** Two sporangia, one with spores shed, \times 30
- c Sporangium, with capillitium, spores and upper part of stalk, × 100
- d Tips of capillitium, with attached scales, and spores, × 500
- e Spore, \times 1000

185 Barbeyella minutissima Meylan

- a Two sporangia, × 5
- b Sporangium, × 50
- c Capillitium arising from columella, and collar at base of sporangium, × 200
- d Spore, $\times 1000$

186 Lamproderma arcyrioides (Sommerf.) Rost.

- a Four sporangia, illustrating variation, × 5
- **b** Two sporangia, showing peridium and capillitium, \times 20
- c Tips of capillitium, and spores, \times 500
- d Spore, \times 1000

187 Lamproderma arcyrionema Rost.

- a Three sporangia, showing variation, × 5
- **b** Two sporangia, \times 20
- c Tips of capillitium, and spores, × 500
- d Spore, \times 1000

188 Lamproderma carestiae (Ces. & de Not.) Meylan

- a Stalked and sessile sporangium, × 5
- **b** Two sporangia, $\times 15$
- c Tips of capillitium, and spores, × 500
- d Spore, \times 1000

189 Lamproderma columbinum (Pers.) Rost.

- a Two sporangia, × 5
- **b** Two sporangia, \times 10
- c Tips of capillitium, and spores, × 500
- d Spore, \times 1000

190 Lamproderma cribrarioides (Fries) R. E. Fries

- a Two sporangia, $\times 5$
- **b** Two sporangia, \times 10
- c Tips of capillitium, and spores, × 500
- d Spore, \times 1000

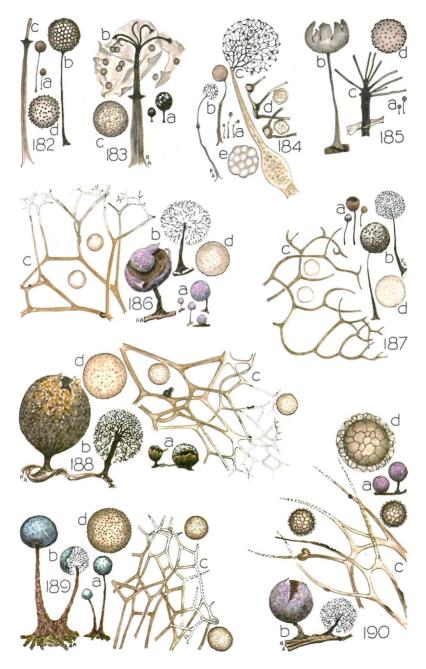


Plate XXI

- 191 Lamproderma cristatum Meylan
 - a Two sporangia, × 5
 - **b** Sporangium, showing columella, capillitium and persistent peridium at base, \times 10
 - c Spore, \times 1000
- 192 Lamproderma echinulatum (Berk.) Rost.
 - a Two sporangia, × 5
 - **b** Obovate sporangium, \times 10
 - c Spore, $\times 1000$
- 193 Lamproderma gulielmae Meylan
 - a Two sporangia, $\times 5$
 - **b** Two sporangia, \times 20
 - c Spore, \times 1000
- 194 Lamproderma muscorum (Lév.) Hagelst.
 - a Two sporangia, × 5
 - **b** Sporangium, × 50
 - c Spore, \times 1000
- 195 Lamproderma pulchellum Meylan
 - a Cluster of sporangia, × 5
 - **b** Two sporangia, \times 20
 - c Denuded sporangium, \times 20
 - d Detail of capillitium, and spores, \times 500
 - e Spore, \times 1000

- 196 Lamproderma atrosporum Meylan
 - a Four sporangia, × 5
 - **b** Denuded sporangium, \times 20
 - Detail of capillitium showing tips attached to fragments of peridium, and spores, × 500
 - d Spore, $\times 1000$
- 197 Lamproderma sauteri Rost.
 - a Group of sporangia, × 5
 - b Sporangium, × 15
 - c Tips of capillitium, and spores, × 500
 - d Spore, \times 1000
- 198 Lamproderma scintillans (Berk. & Br.) Morgan
 - a Three sporangia, $\times 5$
 - b Sporangium, × 40
 - c Capillitium, columella and tip of stalk, × 40
 - d Capillitium arising from tip of columella, showing pale bases of threads, × 100
 - e Spore, \times 1000
- 199 Lamproderma verrucosum Martin, Thind & Sohi
 - a Two sporangia, \times 5
 - **b** Two sporangia, \times 50
 - c Tips of capillitium, and spores, × 500
 - d Spore, \times 1000

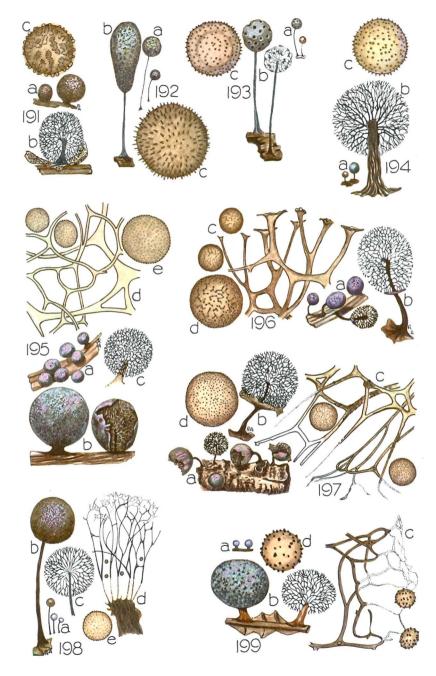


Plate XXII

- 200 Cienkowskia reticulata (Alb. & Schw.) Rost.
 - a Plasmodiocarp, \times 10
 - b Portion of slender plasmodiocarp, × 5
 - c Detail of plasmodiocarp, showing limy plates, × 50
 - d Detail of capillitium, and spores, × 250
 - e Spore, $\times 1000$
- 201 Leocarpus fragilis (Dicks.) Rost.
 - a Sporangia, × 5
 - **b** Broken sporangium, \times 20
 - c Detail of capillitium, and spores, × 250
 - d Spore, \times 1000
- 202 Physarella oblonga (Berk. & Curt.) Morgan
 - a Three sporangia, $\times 5$
 - b Open sporangium, showing spikes and pseudo-columella, \times 20
 - c Sporangium before dehiscence, × 20
 - d Capillitium, spike, and spores, × 250
 - e Spore, \times 1000

- 203 Badhamia affinis Rost.
 - a Cluster of sporangia, $\times 5$
 - b Open sporangium, × 20
 - Capillitium attached to peridium, and spores, × 250
 - d Spore, $\times 1000$
- 204 Badhamia capsulifera (Bull.) Berk.
 - a Group of sporangia, × 5
 - **b** Single sporangium, \times 20
 - c Cluster of spores, \times 500
 - d Isolated spore, \times 1000
- 205 Badhamia dearnessii Hagelst.
 - a Group of sporangia, \times 5
 - **b** Single sporangium, \times 20
 - **c** Two spores, \times 1000
- 206 Badhamia foliicola A. Lister
 - a Cluster of sporangia, × 5
 - **b** Sporangium, \times 20
 - c Spore, \times 1000

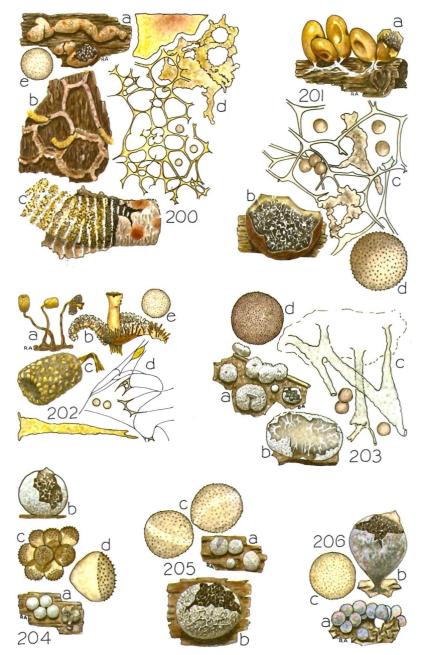


Plate XXIII

207 Badhamia gracilis (Macbr.) Macbr.

- a Group of sporangia, × 5
- **b** Sporangium, \times 20
- c Two spores, \times 1000

208 Badhamia lilacina (Fries) Rost.

- a Group of sporangia, × 5
- **b** Two sporangia, \times 20
- c Open sporangium, \times 20
- **d** Spore, \times 1000

209 Badhamia macrocarpa (Ces.) Rost.

- a Group of sporangia, × 5
- **b** Stalked sporangium, \times 20
- c Detail of capillitium, and spores, × 250
- d spore, \times 1000

210 Badhamia nitens Berk.

- a Cluster of sporangia (after Lister), × 5
- **b** Sporangium, \times 20
- c Cluster of spores, \times 500
- d Same, \times 1000

211 Badhamia obovata (Peck) S. J. Smith

- a Cluster of sporangia (Iowa), × 5
- **b** Same (Massachusetts), × 5
- e Sporangium of B. rubiginosa var. globosa (Wales), × 5
- d Two sporangia (Iowa), one showing columella, × 20
- e Spore (Iowa), \times 1000
- f Same of var. dictyospora, \times 1000
- g Same of var. globosa (Wales), \times 1000

212 Badhamia ovispora Racib.

- a Cluster of sporangia and plasmodiocarps,
 ×5
- **b** Subplasmodiocarpous sporangium, × 50
- c Spore, \times 1000

213 Badhamia panicea (Fries) Rost.

- a Group of sporangia, × 5
- **b** Sporangium, \times 20
- c Two spores, \times 500
- d Spore, $\times 1000$

214 Badhamia papaveracea Berk. & Rav.

- a Three sporangia, × 5
- b Sporangium, × 20
- c Cluster of spores, with free spore, \times 500
- d Spore ball, \times 1000

215 Badhamia populina A. & G. Lister

- a Cluster of sporangia, × 5
- **b** Sporangium, \times 10
- c Spores, partly clustered, × 500
- d Spore, \times 1000

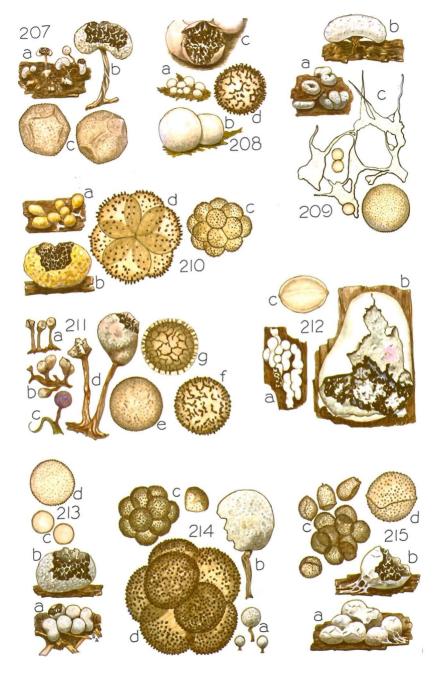


Plate XXIV

216 Badhamia utricularis (Bull.) Berk.

- a Cluster of pendent sporangia, × 5
- **b** Loose cluster of spores, × 500
- c Spore, \times 1000

217 Badhamia versicolor A. Lister

- a Three sporangia, × 5
- **b** Sporangium, peridium partly shed, \times 20
- c Cluster of spores and two free spores, × 500
- d Spore, $\times 1000$

218 Badhamia viridescens Meylan

- a Two sporangia, × 5
- **b** Sporangium, \times 20
- c Two spores, \times 500
- d Spore, \times 1000

219 Fuligo cinerea (Schw.) Morgan

- a Fragment of reticulate aethalium, × 1
- b Detail of same, showing capillitium imbedded in spore-mass, × 20
- c Detail of capillitium, and spores, × 250
- d Spore, \times 1000

220 Fuligo intermedia Macbr.

- a Small aethalium, $\times 1$
- b Detail of broken aethalium, × 20
- c Detail of capillitium, and spores, $\times 250$
- d Spore, $\times 1000$

221 Fuligo megaspora Sturgis

- a Aethalium, $\times 1$
- **b** Detail of broken aethalium, $\times 20$
- c Detail of capillitium, and spores, imes 250
- d Spore, \times 1000

222 Fuligo muscorum Alb. & Schw.

- a Aethalium, $\times 1$
- **b** Detail of same, \times 20
- c Capillitium and spores, \times 250
- d Spore, \times 1000

223 Fuligo septica (L.) Wiggers

- a Small aethalium, × 1
- **b** Same, in section, $\times 1$
- c Detail with cortex removed, $\times 20$
- d Detail of capillitium, and spores, \times 250
- e Spore, $\times 1000$

224 Erionema aureum Penzig

- a Pendent plasmodiocarps, × 10
- **b** Detail, \times 25
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$



Plate XXV

225 Craterium aureum (Schum.) Rost.

a Four sporangia, × 5

b Three sporangia, \times 20

c Detail of capillitium, and spores, × 250

d Spore, $\times 1000$

226 Craterium concinnum Rex

a Three sporangia, × 5

b Two sporangia, \times 20

c Sporangium, × 50

d Detail of capillitium, and spores, × 250

e Spore, $\times 1000$

227 Craterium leucocephalum (Pers.) Ditmar

a Six sporangia, to show variation, × 5

b Two sporangia, \times 20

c Detail of capillitium, and spores, $\times 250$

d Spore, $\times 1000$

228 Craterium minutum (Leers) Fries

a Four sporangia, × 5

b Two sporangia, \times 20

c Detail of capillitium, and spores, × 250

d Spore, $\times 1000$

229 Craterium paraguayense (Speg.) G. Lister

a Four sporangia, × 5

b Two sporangia, \times 20

c Detail of capillitium, and spores, × 250

d Spore, \times 1000

230 Physarum aeneum (A. Lister) R. E. Fries

a Sporangium and small plasmodiocarp, × 5

b Portion of plasmodiocarp, \times 20

c Detail of capillitium, and spores, × 250

d Spore, \times 1000

231 Physarum albescens Ellis

a Group of sporangia, × 5

b Sporangium, \times 20

c Detail of capillitium, and spores, × 250

d Spore, \times 1000

232 Physarum alpinum (A. & G. Lister) G. Lister

a Cluster of fructifications, × 5

b Portion of same, $\times 20$

c Detail of capillitium, and spores, × 250

d Spore, \times 1000

233 Physarum auripigmentum Martin

a Two sporangia, × 5

b Two sporangia, \times 20

c Detail of capillitium, and spores, × 250

d Spore, \times 1000



234 Physarum auriscalpium Cooke

- a Two plasmodiocarps and pulvinate sporangium, yellow phase, × 5
- b Plasmodiocarp, green phase, × 5
- c Pulvinate sporangium, with limeless base, × 20
- d Detail of capillitium, and spores, $\times 250$
- e Spore, \times 1000

235 Physarum bethelii Macbr.

- a Two sporangia, × 5
- **b** Sporangium, \times 20
- c Nearly empty sporangium (type), × 20
- d Detail of capillitium, and spores, × 250
- e Spore, \times 1000

236 Physarum bilgramii Hagelst.

- a Two sporangia, different collections, $\times 5$
- **b** Sporangium, and tip of stalk, showing columella, \times 20
- c Two sporangia, from other fruitings, $\times 20$
- d Detail of capillitium, and spores, × 250
- e Spore, \times 1000

237 Physarum bitectum G. Lister

- a Cluster of fructifications, × 5
- **b** Sporangium, × 20
- c Detail of capililitium, and spores, × 250
- d Spore, $\times 1000$

238 Physarum bivalve Pers.

- a Cluster of fructifications, $\times 5$
- **b** Plasmodiocarp, \times 10
- c Detail of capillitium, and spores, \times 250
- d Spore, \times 1000

239 Physarum bogoriense Racib.

- a Portion of plasmodiocarp, × 5
- **b** Same, $\times 20$
- c Sporangiate fruiting, $\times 20$
- **d** Detail of capillitium, and spores, \times 250
- e Spore, $\times 1000$

240 Physarum braunianum de Bary

- a Five sporangia, $\times 5$
- **b** Sporangium, \times 50
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

241 Physarum brunneolum (Phill.) Massee

- a Sporangium, × 5
- **b** Sporangium, \times 20
- c Same, from above showing double wall, \times 20
- d Detail of capillitium, and spores, $\times 250$
- e Spore, \times 1000

242 Physarum carneum G. Lister & Sturgis

- a Three sporangia, × 5
- **b** Two sporangia, \times 20
- ${f c}$ Detail of capillitium, and spores, imes 250
- **d** Two spores, \times 1000



Plate XXVII

243 Physarum cinereum (Batsch) Pers.

- a Cluster of sporangia, $\times 5$
- **b** Smaller cluster, showing subplasmodiocarpous fruitings, × 20
- c Detail of capillitium, and spores, × 250
- d Spore, \times 1000

244 Physarum citrinum Schum.

- a Three sporangia, × 5
- b/c Two sporangia, × 20
- d Detail of capillitium, and spores, × 250
- e Spore, $\times 1000$

245 Physarum compressum Alb. & Schw.

- a Two sporangia, × 5
- b Sporangium and stalk of another, × 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

246 Physarum confertum Macbr.

- a Cluster of sporangia, × 5
- **b** Same, $\times 20$
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

247 Physarum contextum (Pers.) Pers.

- a Portion of an extensive fruiting, $\times 5$
- b Same, $\times 20$
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

248 Physarum crateriforme Petch

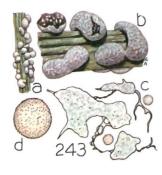
- a Two sporangia, × 5
- **b** Two sporangia, the one at right showing columella, × 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

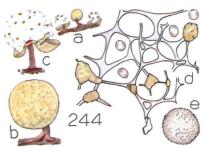
249 Physarum decipiens Curtis

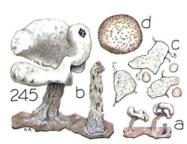
- a Cluster of sporangia, $\times 5$
- **b** Same, \times 20
- c Detail of capillitium, and spores, \times 250
- d Spore, $\times 1000$

250 Physarum dictyosporum Martin

- a Three sporangia, × 5
- b Three fructifications approaching plasmodiocarp type, × 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

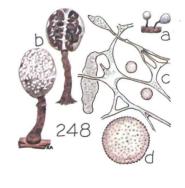


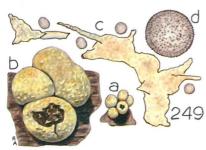












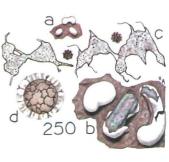


Plate XXVIII

251 Physarum diderma Rost.

- a Cluster of sporangia, × 5
- **b** Sporangium, $\times 20$
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

252 Physarum didermoides (Pers.) Rost.

- a Portion of large fruiting, ×5
- **b** Three sporangia, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

253 Physarum digitatum G. Lister & Farq.

- a Cluster of sporangia, × 5
- **b** Detail of same, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

254 Physarum echinosporum G. Lister

- a Cluster of plasmodiocarps, × 5
- **b** Two plasmodiocarps, × 10
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

255 Physarum flavicomum Berk.

- a Three sporangia with stalk of another, × 5
- b Two sporangia, × 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

256 Physarum flavidum (Peck) Peck

- a Four sporangia, $\times 5$
- **b** Sporangium, \times 20
 - c Detail of capillitium, and spores, \times 250
- d Spore, $\times 1000$

257 Physarum galbeum Wingate

- a Three sporangia, × 5
- **b** Two sporangia, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

258 Physarum globuliferum (Bull.) Pers.

- a Two sporangia, with stalks of two others, one showing columella, × 5
- b Other sporangia and stalks, to show variation, × 5
- c Two sporangia, with tip of another showing columella. × 20
- d Sporangium, pinkish phase with scanty lime, × 20
- e Detail of capillitium, and spores, × 250
- f Spore, $\times 1000$

259 Physarum gyrosum Rost.

- a Small plasmodiocarp, × 5
- **b** Same, \times 20
- c Detail of same, showing spike-like nodes, \times 50
- d Detail of capillitium, and spores, × 250
- e Spore, \times 1000

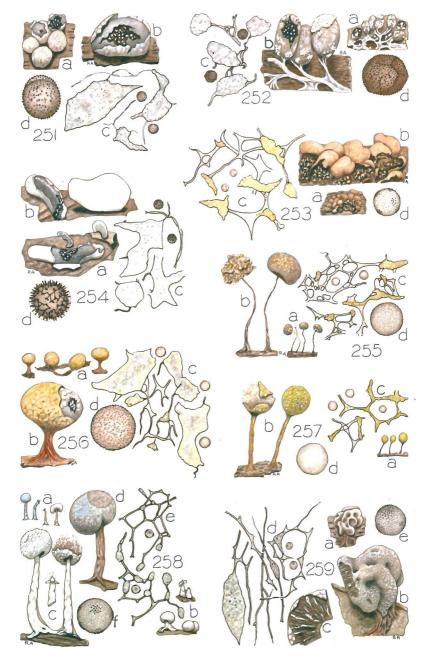


Plate XXIX

260 Physarum javanicum Racib.

- a Cluster of sporangia, × 5
- **b** Sporangium, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

261 Physarum lateritium (Berk. & Rav.) Morgan

- a Two sporangia, × 5
- **b** Sporangium, × 20
- c Detail of capillitium, and spores, \times 250
- d Spore, $\times 1000$

262 Physarum leucophaeum Fries

- a Three sporangia, × 5
- **b** Two sporangia, × 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

263 Physarum leucopus Link

- a Sporangium, × 5
- **b** Two sporangia, \times 20
- c Detail of capillitium, and spores, \times 250
- d Spore, $\times 1000$

264 Physarum listeri Macbr.

- a Two sporangia, × 5
- **b** Two sporangia, \times 10
- c Portion of stem, showing crystalline inclusions, × 50
- d Detail of capillitium, and spores, \times 250
- e Spore, $\times 1000$

265 Physarum lutescens Peck

- a Cluster of sporangia, × 5
- **b** Sporangium, \times 20
- c Detail of capillitium, and spores, $\times 250$
- d Spore, \times 1000

266 Physarum megalosporum Macbr.

- a Three sporangia, × 5
- **b** Two sporangia, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

267 Physarum melleum (Berk. & Br.) Massee

- a Four sporangia, × 5
- **b** Sporangium, and base of another, showing columella, $\times 20$
- c Detail of capillitium, and spores, \times 250
- d Spore, \times 1000

268 Physarum mennegae Nann.-Brem.

- a Sporangium, × 5
- **b** Same, with stalk showing columella, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore, \times 1000

269 Physarum mortoni Macbr.

- a Cluster of sporangia, × 5
- **b** Sporangium, with weak, prostrate stalk, $\times 20$
- c Detail of capillitium, and spores, × 250
- d Spore, \times 1000



Plate XXX

270 Physarum murinum A. Lister

- a Two sporangia, $\times 5$
- b Two sporangia, one showing columella, $\times 20$
- c Detail of capillitium, and spores, × 250
- d Spore, \times 1000

271 Physarum mutabile (Rost.) G. Lister

- a Two sporangia, × 5
- b Plasmodiocarp (after Lister), × 5
- c Two sporangia, one showing columella, $\times 20$
- d Detail of capillitium, and spores, $\times 250$
- e Spore, $\times 1000$

272 Physarum nicaraguense Macbr.

- a Two sporangia, with stalks of others, × 5
- b Sporangium, ×20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

273 Physarum notabile Macbr.

- a Cluster of sporangia, × 5
- b Isolated sporangium, × 20
- c Cluster of sporangia, × 20
- d Detail of capillitium, and spores, × 250
- e Spore, $\times 1000$

274 Physarum nucleatum Rex

- a Cluster of sporangia, × 5
- **b** Two sporangia, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore, \times 1000

275 Physarum nudum Macbr.

- a Cluster of sporangia, × 5
- **b** Sporangium, \times 40
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

276 Physarum nutans Pers.

- a Three sporangia, × 5
- b Two sporangia, × 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

277 Physarum oblatum Macbr.

- a Two sporangia, with stalk of another, × 5
- **b** Two sporangia, \times 20
- c Flabellate sporangium with short stem from same fruiting as b, × 20
- d Detail of capillitium, and spores, × 250
- e Spore, $\times 1000$

278 Physarum ovisporum G. Lister

- a Sporangium and small plasmodiocarps,
 ×5
- **b** Sporangium, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

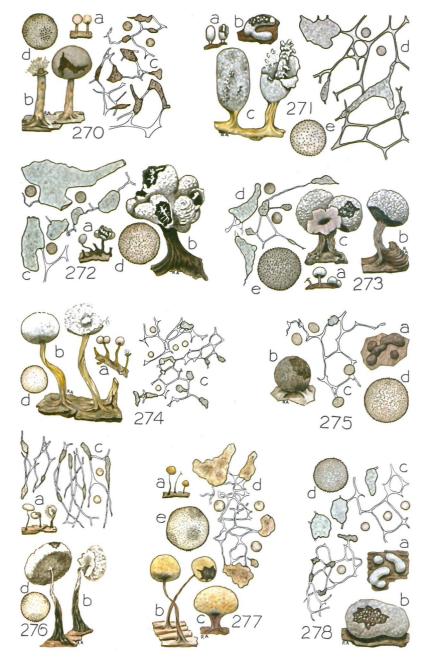


Plate XXXI

279 Physarum penetrale Rex

- a Two sporangia, $\times 5$
- b Same, $\times 20$
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

280 Physarum pezizoideum (Jungh.) Pav. & Lag. var. pezizoideum

- a Two sporangia, × 5
- **b** Same, \times 20
- c Detail of capillitium, showing attachment to base of peridium, and spores, × 250
- d Spore, \times 1000

281 Physarum polycephalum Schw.

- a Two sporangia, × 5
- b Same, $\times 20$
- c Detail of capillitium, and spores, × 250
- d Spore, \times 1000

282 Physarum psittacinum Ditmar

- a Four sporangia, × 5
- b/c Three sporangia, × 20
- d Detail of capillitium, and spores, × 250
- e Spore, \times 1000

283 Physarum pulcherrimum Berk. & Rav.

- a Two sporangia, × 5
- b Two sporangia and remains of third, showing columella, × 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

284 Physarum pulcherripes Peck

- a Two sporangia and remnant of third, showing columella, × 5
- **b** Two sporangia, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore \times 1000

285 Physarum pusillum (Berk. & Curt.) G. Lister

- a Three sporangia, × 5
- b Two sporangia, × 20
- c Detail of capillitium, and spores from collection with physaroid capillitium, \times 250
- d Same, from collection with somewhat badhamioid capillitium, × 250
- e Spore, $\times 1000$

286 Physarum retisporum Martin, Thind & Rehill

- a Two fructifications, $\times 5$
- **b** Sporangiate fruiting, \times 20
- c Plasmodiocarpous fruiting, $\times 20$
- d Detail of capillitium, and spores, × 250
- e Spore, \times 1000



Plate XXXII

287 Physarum roseum Berk. & Br.

- a Six sporangia, × 5
- **b** Two sporangia, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore, \times 1000

288 Physarum rubiginosum Fries

- a Cluster of brown sporangia, × 5
- **b** Two red sporangia, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore, \times 1000

289 Physarum rubronodum Martin

- a Part of a cluster of sporangia, × 5
- b Sporangium, × 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

290 Physarum serpula Morgan

- a Plasmodicarps, × 5
- **b** Sporangiate fruiting, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

291 Physarum spinulosum Thind & Sehgal

- a Cluster of sporangia, × 5
- **b** Same, \times 10
- c Detail of capillitium, and spores, $\times 250$
- d Spore, $\times 1000$

292 Physarum stellatum (Massee) Martin

- a Cluster of sporangia (after Lister), × 5
- **b** Two sporangia, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore, \times 1000

293 Physarum straminipes A. Lister

- a Cluster of sporangia, × 5
- **b** Two sporangia, the stalks fused, \times 20
- c Detail of capillitium, and spores, $\times 250$
- d Spore, \times 1000

294 Physarum sulphureum Alb. & Schw.

- a Two stalked sporangia, × 5
- b Sessile sporangium, × 5
- c Sporangium, \times 20
- d Detail of capillitium, and spores, × 250
- e Spore, $\times 1000$

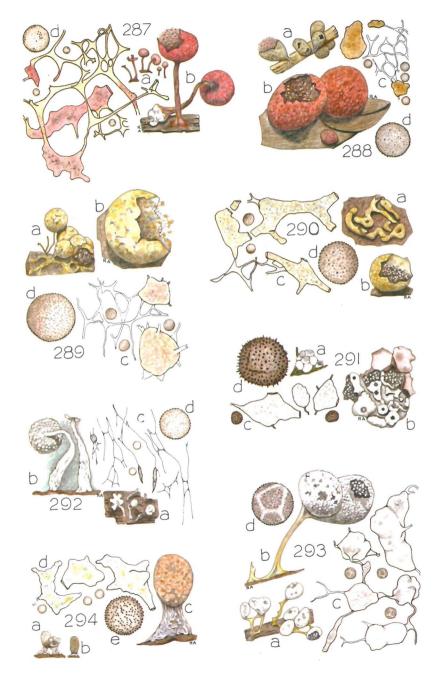


Plate XXXIII

295 Physarum superbum Hagelst.

- a Sporangium and plasmodiocarps, × 5
- **b** Plasmodiocarp, \times 20
- c Detail of capillitium, and spores, $\times 250$
- d Spore, $\times 1000$

296 Physarum tenerum Rex

- a Sporangia, × 5
- **b** Two sporangia, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

297 Physarum tessellatum Martin & Farr

- a Cluster of sporangia, × 5
- **b** Portion of same, $\times 20$
- c Detail of capillitium, and spores, \times 250
- d Spore, $\times 1000$

298 Physarum tropicale Macbr.

- a Sporangium and stalk of another, \times 5
- **b** Sporangium, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

299 Physarum vernum Somm.

- a Two clustered fructifications, × 5
- b Detail of capillitium, and spores, × 250
- c Spore, \times 1000

300 Physarum virescens Ditmar

- a Cluster of sporangia, × 5
- **b** Same, \times 20
- ${f c}$ Detail of capillitium, and spores, imes 250
- d Spore, $\times 1000$

301 Physarum viride (Bull.) Pers.

- a Four sporangia, × 5
- b Yellow sporangium with broken peridium, $\times 20$
- c Paler sporangium, \times 20
- d White sporangium showing yellow nodes
- e Detail of capillitium, and spores, × 250
- f Spore, $\times 1000$

302 Wilczekia evelinae Meylan

- a Two sporangia, × 5
- b Sporangium, × 20
- c Detail of capillitium, and spores, × 250
- d Spore, \times 1000

303 Physarina echinospora Thind & Manocha

- a Two sporangia, × 5
- **b** Sporangium, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore, \times 1000



Plate XXXIV

304 Diderma alpinum Meylan

- a Part of a large cluster of fruitings, ×5
- **b** Detail of capillitium, calcareous body, and spores, \times 250
- c Spore, \times 1000

305 Diderma asteroides (A. & G. Lister) G. Lister

- a Group of sporangia, × 5
- **b** Open sporangium, × 20
- c Detail of capillitium, with spores, × 250
- d Spore, $\times 1000$

306 Diderma chondrioderma (de Bary & Rost.) G. Lister

- a Cluster of sporangia, $\times 5$
- **b** Same, $\times 20$
- c Detail of capillitium, with tips attached to peridium, and spores, $\times\,250$
- d Spore, $\times 1000$

307 Diderma cinereum Morgan

- a Cluster of sporangia, × 5
- **b** Same, $\times 20^{\circ}$
- c Detail of capillitium, and spores, \times 250
- d Spore, $\times 1000$

308 Diderma cor-rubrum Macbr.

- a Two sporangia, with hypothallus, × 5
- b Three sporangia, one showing columella, × 20
- c Detail of capillitium, with spores and crystalline bodies, $\times\,250$
- d Spore, $\times 1000$

309 Diderma crustaceum Peck

- a Part of an extensive fruiting, × 5
- **b** Portion of same, \times 20
- c Detail of capillitium, and spores, \times 250
- d Spore, $\times 1000$

310 Diderma darjeelingense Thind and Sehgal

- a Three sporangia, × 5
- **b/c** Three sporangia, \times 20
- d Detail of capillitium, and spores, × 250
- e Spore, \times 1000

311 Diderma deplanatum Fries

- a Plasmodiocarp, × 5
- b Annulate plasmodiocarp, showing inner wall, × 20
- c Detail of capillitium, and spores, \times 250
- d Spore, \times 1000

312 Diderma effusum (Schw.) Morgan

- a Part of a large sporangiate fruiting, × 5
- **b** Plasmodiocarp, \times 5
- c Mass of small, almost merged sporangia,
 × 5
- d Detail of capillitium, and spores, × 250
- e Spore, $\times 1000$

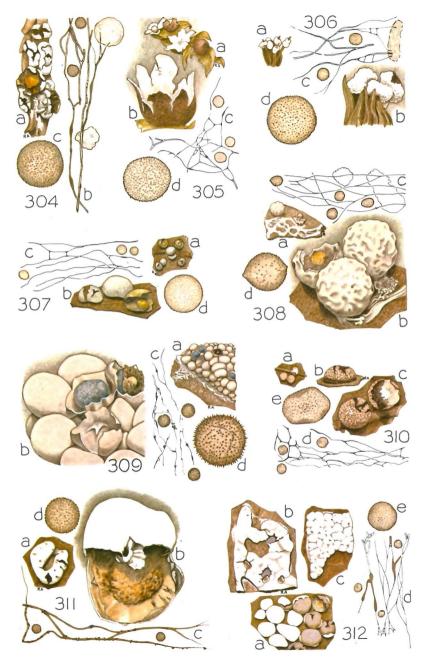


Plate XXXV

313 Diderma floriforme (Bull.) Pers.

- a Cluster of sporangia, $\times 5$
- **b** Two sporangia, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

314 Diderma globosum Pers.

- a Group of sporangia, × 5
- b Three sporangia, × 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

315 Diderma hemisphaericum (Bull.) Hornem.

- a Group of sporangia, × 5
- **b** Sporangium, $\times 20$
- c Detail of capillitium, and spores, \times 250
- d Spore, $\times 1000$

316 Diderma indicum Thind & Sehgal

- a Cluster of sporangia, × 5
- b Detail of capillitium, and spores, × 250
- c Spore, \times 1000

317 Diderma lucidum Berk. & Br.

- a Sporangium, × 5
- **b** Two sporangia, \times 20
- Detail of capillitium showing attachment to fragment of peridium, and spores, × 250
- d Spore, $\times 1000$

318 Diderma lyallii (Massee) Macbr.

- a Group of sporangia, × 5
- b Sporangium, × 20
- c Detail of capillitium, and spores, × 250
- d Spore, \times 1000

319 Diderma montanum (Meylan) Meylan

- a Three sporangia, \times 5
- **b** Sporangium, \times 20
- c Detail of capillitium, and spores, \times 250
- d Spore, $\times 1000$

320 Diderma mussooriense Thind & Manocha

- a Cluster of sporangia, × 5
- **b** Two sporangia, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

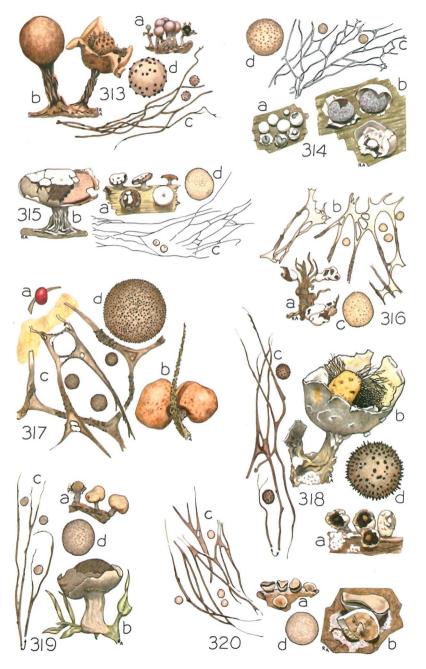


Plate XXXVI

321 Diderma niveum (Rost.) Macbr.

- a Cluster of sporangia, × 5
- **b** Detail of capillitium, and spores, \times 250
- c Spore, $\times 1000$

322 Diderma ochraceum Hoffm.

- a Three sporangia, × 5
- **b** Sporangium, $\times 20$
- c Details of capillitium, and spores, \times 250
- d Spore, $\times 1000$

323 Diderma radiatum (L.) Morgan

- a Cluster of sporangia, × 5
- b Weathered sporangium, × 10
- c Detail of capillitium, and spores, \times 250
- d Spore, \times 1000

324 Diderma roanense (Rex) Macbr.

- a Three sporangia, × 5
- **b** Sporangium, \times 10
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

325 Diderma rugosum (Rex) Macbr.

- a Two sporangia, × 5
- **b** Two sporangia, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore, \times 1000

326 Diderma simplex (Schroet.) G. Lister

- a Group of sporangia, × 5
- **b** Sporangium, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore, \times 1000

327 Diderma spumarioides (Fries) Fries

- a Part of a large cluster of sporangia, × 5
- b Sporangium cut through center to show columella, with base of old sporangium, × 20
- c Detail of capillitium, and spores, × 250
- d Spore, \times 1000

328 Diderma subdictyosporum (Rost.) G. Lister

- a Details of capillitium, and spores, × 250
- **b** Spore, $\times 1000$

329 Diderma testaceum (Schrad.) Pers.

- a Group of sporangia, × 5
- **b** Sporangium, \times 20
- c Detail of capillitium, and spores, × 250
- d Spore, $\times 1000$

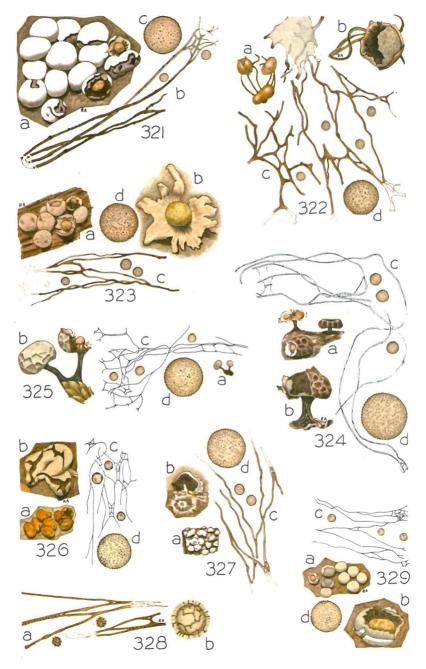


Plate XXXVII

330 Diderma travelyani (Grev.) Fries

- a Cluster of sporangia, × 5
- b Two sporangia, one before opening, the other after spore discharge, × 10
- c Details of capillitium, portion of peridium with imbedded lime crystals, and spores, × 250
- d Spore, $\times 1000$

331 Mucilago crustacea Wiggers

- a Small aethalium, × ½
- b Detail, showing portions of capillitium and pseudocapillitium, with crystals and spores, × 250
- c Spore, \times 1000

332 Didymium anellus Morgan

- a Cluster of fructifications, × 5
- **b** Plasmodiocarp, × 20
- c Detail of capillitium, with crystals and spores, × 250
- d Spore, $\times 1000$

333 Didymium clavus (Alb. & Schw.) Rab.

- a Two sporangia, ×5
- **b** Three sporangia, \times 20
- c Detail of capillitium, with crystals and spores, × 250
- d Spore, \times 1000

334 Didymium crustaceum Fries

- a Massed sporangia, × 5
- b Sporangia, one with stalk-like hypothallus, × 10
- Detail of capillitium, with crystals and spores, × 250
- d Spore, \times 1000

335 Didymium decipiens Meylan

- a Portions of capillitium, and spores, \times 250
- **b** Spore, $\times 1000$

336 Didymium difforme (Pers.) S. F. Gray

- a Cluster of fruitings, × 5
- b Plasmodiocarp, × 20
- Detail of capillitium, with crystals and spores, × 250
- d Spore, \times 1000

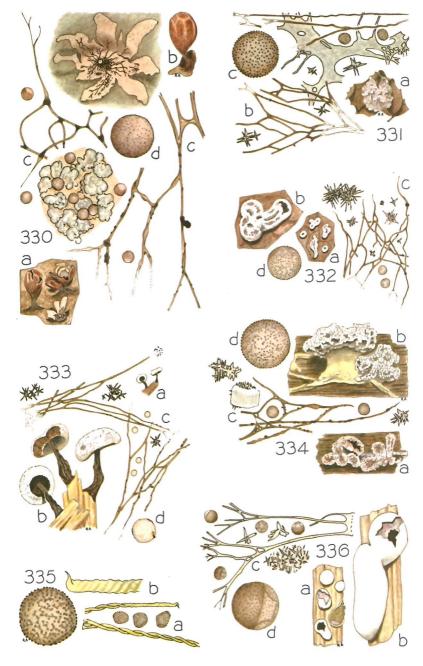


Plate XXXVIII

337 Didymium dubium Rost.

- a Plasmodiocarp, × 5
- b Detail of capillitium, with spores and crystals. × 250
- c Spore, \times 1000

338 Didymium megalosporum Berk. & Curt.

- a Three sporangia, × 5
- **b** Two sporangia, one showing internal structure, × 20
- c Detail of capillitium showing attachment to peridium, with spores and crystals, × 250
- d Spore, \times 1000

339 Didymium flexuosum Yamashiro

- a Portion of plasmodiocarp, × 5
- b Enlarged detail of same, × 20
- c Detail of capillitium, with vesicular bodies, spores and crystals, × 250
- d Spore, \times 1000

340 Didymium floccosum Martin, Thind & Rehill

- a Two sporangia, × 5
- b Two sporangia with columella of a third, × 20
- c Detail of capillitium showing attachment to peridium, with crystals and spores, $\times 250$
- d Spore, $\times 1000$

341 Didymium fulvum Sturgis

- a Plasmodiocarp, × 5
- **b** Detail of capillitium, with spores and crystals, × 250
- c Spore, \times 1000

342 Didymium intermedium Schroet.

- a Group of sporangia, × 5
- **b** Two sporangia, that on right showing deep umbilicus, × 20
- c Detail of capillitium, with spores, crystals, and part of stalk with included crystals, × 250
- d Spore, \times 1000

343 Didymium iridis (Ditmar) Fries

- a Group of sporangia, × 5
- **b** Sporangium, \times 20
- c Detail of capillitium, with spores and crystals, × 250
- d Spore, $\times 1000$

344 Didymium leoninum Berk. & Br.

- a Sporangium, × 5
- b Two sporangia, × 20
- Detail of capillitium, showing attachment to peridium, with spores and crystals, × 250
- d Spore, × 1000



Plate XXXIX

345 Didymium listeri Massee

- a Small plasmodiocarp, × 5
- **b** Sporangium, \times 20
- c Details of capillitium, with spores and crystals, \times 250
- d Spore, $\times 1000$

346 Didymium melanospermum (Pers.) Macbr.

- a Two sporangia, $\times 5$
- **b** Same, \times 20
- c Portion of peridium, showing attached capillitium, ×50
- d Detail of same, with spores and crystals, × 250
- e Spore, \times 1000

347 Didymium minus (A. Lister) Morgan

- a Sporangium, × 5
- b Two sporangia, × 20
- c Details of capillitium, showing attachment to peridium, with crystals and spores, × 250
- d Spore, \times 1000

348 Didymium nigripes (Link) Fries

- a Sporangium, × 5
- **b** Two sporangia, \times 20
- c Details of capillitium, showing attachment to peridium, with crystals and spores, × 250
- d Spore, \times 1000

349 Didymium ochroideum G. Lister

- a Three sporangia, × 5
- **b** Five sporangia, \times 20
- c Detail of capillitium, with spores and crystals, × 250
- d Spore, $\times 1000$

350 Didymium ovoideum Nann.-Brem.

- a Sporangium, × 5
- **b** Two sporangia, \times 20
- c Empty sporangium showing rugose columella, × 20
- d Detail of capillitium, showing enlargements and attachment to peridium, with crystals and spores, $\times 250$
- e Spore, \times 1000

351 Didymium perforatum Yamashiro

- a Portion of plasmodiocarp, × 5
- **b** Detail of same, $\times 20$
- c Detail of capillitium, with crystals and spores, \times 250
- d Spore, × 1000



Plate XI.

352 Didumium quitense (Pat.) Torrend

- a Three fructifications, $\times 5$
- b Detail of capillitium, with crystals and spores, × 250
- c Spore, \times 1000

353 Didymium serpula Fries

- a Plasmodiocarps. × 5
- b Detail of plasmodiocarp, × 20
- c Details of capillitium, with vesicles, crystals and spores, × 250
- d Spore, \times 1000

354 Didymium squamulosum (Alb. & Schw.) Fries

- a Sporangia, × 5
- b/c Sporangia, × 20
- d Detail of capillitium showing attachment to peridium, with crystals and spores, × 250
- e Spore, \times 1000

355 Didymium sturgisii Hagelst.

- a Plasmodiocarp, × 5
- **b** Detail of same, \times 20
- c Diagram of same, showing trabeculae, × 20
- d Detail of capillitium showing attachment to peridium, with trabeculae, crystals and spores, × 250
- e Spore, \times 1000

356 Didymium trachysporum G. Lister

- a Cluster of sporangia, × 5
- **b** Three sporangia, \times 20
- Details of capillitium, with fragment of peridium, crystals and spores, × 250
- d Spore, \times 1000

357 Didymium vaccinum (Dur. & Mont.) Buchet

- a Cluster of fructifications, × 5
- **b** Sporangium, \times 20
- c Detail of capillitium, showing attachment to columella, with crystals and spores, × 250
- d Spore, × 1000 (California)
- e Spore, \times 1000 (England)

358 Didymium verrucosporum Welden

- a Sporangia, × 5
- **b** Two sporangia, \times 20
- c Detail of capillitium, with attached peridial fragment, and crystals and spores, × 250
- d Spore, × 1000



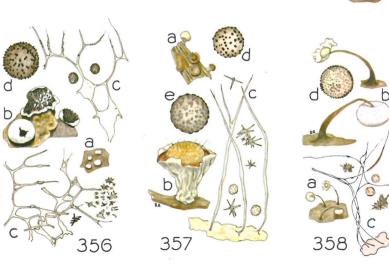


Plate XLI

359 Lepidoderma carestianum (Rab.) Rost.

- a Sporangiate and plasmodiocarpous fructifications, × 5
- **b** Capillitium and spores, \times 250
- c Spore, \times 1000

360 Lepidoderma chailletii Rost.

- a Cluster of sporangia, × 5
- **b** Sporangium, \times 20
- c Capillitium, cluster of crystals from scale, and spores, × 250
- d Spore, \times 1000

361 Lepidoderma granuliferum (Phill.) R. E. Fries

- a Fructifications, × 5
- b Capillitium, with vesicles containing crystals, and spores, $\times 250$
- c Spore, \times 1000

362 Lepidoderma tigrinum (Schrad.) Rost.

- a Sporangium, × 5
- **b** Sporangium, \times 10
- c Capillitium, scales, and spores, × 250
- d Spore, \times 1000

363 Leptoderma iridescens G. Lister

- a Three sporangia, two partly fused, $\times 5$
- **b** Four sporangia, \times 20
- c Capillitium, showing attachment to peridium, and spores, × 250
- d Spore, \times 1000

364 Didymium laxifila G. Lister & Ross

- a Cluster of sporangia, × 5
- **b** Sporangium, \times 20
- c Capillitium, crystals, and spores, × 250
- d Spore, $\times 1000$

365 Licea pumila Martin & Allen

- a Cluster of sporangia, × 5
- **b** Two sporangia, \times 50
- c Spore, × 1000

366 Badhamia ainoae Yamashiro

- a Three sporangia, × 5
- b Sporangium, partly open, to show limy columns, × 20
- c Single column, with fragments of base and peridium attached, and spores,
- d Spore, $\times 1000$

367 Hemitrichia chrysospora (A. Lister) A. Lister

- a Sporangia and plasmodiocarps, × 10
- b Capillitium and spores, × 500
- c Spore, \times 1000

